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THESIS

A STUDY OF THE HANDLING OF LESSONS PROCESSING IN LESSONS LEARNED SYSTEMS AND APPLICATION TO LESSONS LEARNED SYSTEM DESIGN

by

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September 2002

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This research evaluates a sample of Lessons Learned Systems for their method of handling lessons. It provides a coding that allows a Lessons Learned System to be characterized over the spectrum of possible handling methods. It relates this coding to its effect on the three tasks of a Lessons Learned System: collecting lessons, insuring quality of lessons for dissemination and dissemination of the lessons such that implementation occurs.

This method allows for Lessons Learned System evaluation and design with respect to the handling of lessons.

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A STUDY OF THE HANDLING OF LESSONS PROCESSING IN LESSONS LEARNED SYSTEMS AND APPLICATION TO LESSONS LEARNED SYSTEM DESIGN

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TABLE OF CONTENTS

LIST OF FIGURES

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LIST OF TABLES

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I. INTRODUCTION

A. PURPOSE

This thesis has three purposes.

The first is to increase the body of knowledge that exists for Lessons Learned Systems. As resources for organizational application become limited, it is important that those resources are used in the most efficient manner. A properly operating Lessons Learned Systems will increase the efficiency of operation. Further, safety of operation may also be increased with a properly operating Lessons Learned System. Documenting and analyzing existing Lessons Learned Systems will provide future designers of Lessons Learned Systems a resource and a foundation upon which to build.

The second purpose is to focus the various methods of lessons handling.

> Handling refers to the level of treatment given a lesson after it has been generated.[1]

The focus is to provide a characterization that will encompass the various methods of lessons handling. Further, the characterization will be a tool for the design or architecture of a Lessons Learned System by connecting the characterization to successful operation of a Lessons Learned System

The third purpose is to apply the characterization of lessons handling and its relation to successful operation to the SUPSHIP[2] Groton Lessons Learned System. The application may provide recommendations for improvement.

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[1] Snider, K. F., Barrett, F. J., & Tenkasi R. (2002).

[2] Supervisor of Shipbuilding, Conversion and Repair, Groton, CT.

B. BACKGROUND

The Defense Systems Management College defines Lessons Learned as: Capitalizing on past errors in judgment, materiel failures, wrong timing, or other mistakes to ultimately improve a situation or system.[3] It defines a system as: The organization of hardware, software, material, facilities, personnel, data, and services needed to perform a designated function with specified results, such as the gathering of specified data, its processing, and delivery to users.[4]

A Lessons Learned System is integral to any organization's process of achieving its full potential. Although full potential may have a different meaning to different organizations, all would probably equate achieving full potential with success.

> Success comes from wisdom. Wisdom comes from experience. Experience comes from mistakes.[5]

How can success come from making mistakes? The answer, of course, is to learn from mistakes so that the same mistakes are not repeated again.

> Those who cannot remember the past are condemned to repeat it.[6]

The existence of a Lessons Learned System alone does not guarantee that mistakes will not be repeated. The Lessons Learned System must be properly designed in terms of collecting lessons, processing the lessons, disseminating the lessons and follow up activities to insure that the lessons learned are properly implemented.

The Lessons Learned System must also be appropriate to the organization. The success of any system is dependent on proper architecture. One aspect of proper architecture is that the system provides a useful purpose.

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3 *Glossary, Defense Acquisition Acronyms and Terms* (2001).

4 Ibid.

5 Maier, M. W., & Eberhardt, R. (2000). *The Art of Systems Architecting.* (2nd ed.). Boca Raton, London, NY, Washington D.C: CRC Press., page 17

6 Santayana, George (1863-1952), Retrieved 2002, from http://www.chesco.com/`artnab.sntayana.html

No system can survive that doesn't serve a useful purpose.[7]

Understanding the properties of a Lessons Learned System is done by a methodology that is used to understand any complicated system, the methodology of decomposition. The Lessons Learned System is broken down into its components or working parts. Understanding the working parts and their relationship to one another helps in understanding the collection of the working parts that is the system.

An earlier decomposition was included in a presentation made to the U.S. Department of Energy Society for Effective Lessons Learned Sharing Spring 2000 Meeting.[8] In that presentation, characteristics of a Lessons Learned System were named Contents, Organizational Type, Process Type, Target Process Relation, Dissemination Type and Recommendation.

The decomposition was further refined in an Acquisition Review Quarterly article.[9] It was proposed that the characteristics of a Lessons Learned System be grouped by Lesson, Operational and Organizational factors. These three main characteristics were further sub-divided into sub-characteristics. The previous characteristics presented before the Society for Effective Lessons Learned Sharing were included in this level, as were new characteristics. The qualitative value for each characteristic of the collection described in an organized fashion a Lessons Learned System.

Listed under the Operational category is the characteristic called Handling. The qualitative value for Handling ranges from rigorous to open. A Lessons Learned System that employs rigorous Handling would evaluate each lesson in a formal manner. A possible example of formal Handling might be a determination of the root cause of the lesson. Another example might be determining where or to who the lesson should be disseminated. A Lesson Learned System that employs open Handling would accept any lesson as valid and disseminate.

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[7] Hillaker, Harry (1989), chief architect, General Dynamics F-16 Fighter, as stated in a USC Systems Architecting lecture, November 1989.

[8] Aha, D. W. (2000).

[9] Snider, K. F., Barrett, F. J., & Tenkasi R. (2002).

One objective of this research is to analyze the Handling characteristic. It is to establish a listing of the various ways lessons are "handled". It is to provide a characterization of these handling methods and determine a cause and effect relationship that can be used for Lessons Learned System design or architecture.

The Supervisor of Shipbuilding, Conversion and Repair, Groton CT (SUPSHIP Groton), a Naval Sea Systems Command (NAVSEA) Field Activity, is the Government's on-site design, manufacturing, and construction/repair management team for submarines designed and manufactured at Electric Boat, Groton, CT.[10] As part of its strategic/business planning, SUPSHIP has adopted a Balanced Scorecard format for improvement.[11] One focus area is "customer". One strategy to improve customer satisfaction is the initiation of a Lessons Learned System.

Another objective of this research is to apply the results of the cause and effect of the handling characteristics towards the design of the SUPSHIP Groton Lessons Learned System.

C. RESEARCH QUESTIONS

The primary research question of this thesis is: How may a Lessons Learned System be characterized according to the handling of lessons processing, and how may such a characterization be applied to Lessons Learned System design or architecture?

The subsidiary research questions are as follows:

1. How are lessons processed or handled in a sample of Lessons Learned Systems?
2. What are the effects of these ways of lesson processing or handling on Lessons Learned System operation?
3. To what extent will the ways of lesson processing or handling of the SUPSHIP Groton Lessons Learned System support successful operation?

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[10] SUPSHIP Groton, CT (2002), page 1.

[11] Ibid., page 3.

D. BENEFITS OF STUDY

The benefit of this research is to increase the body of knowledge that exists for a Lessons Learned System. It provides a sampling of Lessons Learned Systems and a collection of handling methods for those Lessons Learned Systems. It provides some benefits and consequences of these handling methods.

The benefits of this research also include one method to characterize the handling of lessons by a Lessons Learned System. It also allows application to Lessons Learned System design or architecture.

The last benefit is an evaluation of the design of the SUPSHIP Groton Lessons Learned System with possible recommendations for improved operations.

E. SCOPE AND METHODOLOGY

The scope of the thesis will include: (1) identifying numerous Lessons Learned Systems, (2) acquiring information on the operation of the Lessons Learned Systems with focus on the handling of lessons, (3) determining a relationship between this handling and operations, (4) characterization of the handling in an encompassing manner, (5) relating the characterization to design or architecture and (6) apply the relationship to the SUPSHIP Groton Lessons Learned System.

The nature of this thesis work is exploratory in nature. It is based on a sampling of Lessons Learned Systems. The analysis is of a qualitative nature and is based on empirical evidence or shared experiences from the Lessons Learned System sample. Theoretical principles of Knowledge Management and Organizational Learning provide a map to explore consequences of handling methods.

The methodology used in this thesis research will consist of the following steps:

1. Review literature for Lessons Learned System basics including instructions for Government Lessons Learned Systems.
2. Review literature in the areas of Knowledge Management and Organizational Learning.
3. Conduct an Internet search of existing Lessons Learned Systems.

4. Make personal contact with a person involved in each Lessons Learned System.

5. Provide a questionnaire and supplement by e-mails/phone calls to obtain necessary data.

6. Organize the data in a form that allows for analysis.

7. Analyze the data to provide connections between handling methods and their consequences to a Lessons Learned System.

8. Use the results to suggest an appropriate Handling characteristic for the SUPSHIP Lessons Learned System.

F. ORGANIZATION OF STUDY

This thesis is a team effort. The team consists of the author, principal advisor and associate advisor. The author is responsible for research and composition. The principal advisor is responsible for guiding the author in his research and composition through reviews of completed chapters. The associate advisor is responsible for guidance in the local arena that is SUPSHIP Groton.

A thesis proposal was developed and approved. A product of the thesis proposal is an organization of the thesis by chapters. The chapters are:

1. Chapter I. Introduction This chapter describes the purpose of the thesis. It also provides a general background that is helpful in understanding the nature of the thesis. It includes the primary and subsidiary research questions.

2. Chapter II. Literature Review This chapter provides a summary of the appropriate research literature that is relevant to the thesis. The existing research literature provides a conceptual foundation for the thesis.

3. Chapter III. Methodology This chapter describes the approach used to answer the primary research question. It describes what data is necessary and how it will be analyzed.

4. Chapter IV. Existing Lessons Learned Systems This chapter contains the data collected about existing Lessons Learned Systems. It organizes the data in a form that can be used in analysis.

5. Chapter V. Analysis This chapter analyzes the data and answers the primary research question.

6. Chapter VI. Application to SUPSHIP Groton This chapter applies the results of the analysis to the SUPSHIP Groton Lessons Learned System

7. Chapter VII. Conclusion This chapter provides closing remarks concerning the primary research question, limitations of the research and recommendations for future research.

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II. LITERATURE REVIEW

A. INTRODUCTION

The purpose of this chapter is to highlight existing theoretical and research information that is relevant to this thesis. The existing theoretical and research literature provides a conceptual foundation for the thesis. It provides a framework onto which the work of this thesis can be placed.

It also provides information about Lessons Learned System structures that exist. This chapter provides the vocabulary of a Lessons Learned System.

Section B provides general definitions relevant to a Lessons Learned System. Section C provides information from Army Lessons Learned System documents. It discusses goals of a Lessons Learned System and provides the tasks that a Lessons Learned System must perform in order to achieve its goals. Section D provides information on Department of Energy Lessons Learned System documents. It discusses goals and tasks. It also specifies the use of root cause analysis for handling of lessons. Section E provides analysis work done on the operation of a Lessons Learned System by examining the effects of different characteristics. It also formally defines the term Handling as in the handling of lessons. Section F provides information on Knowledge Management basics of which a Lessons Learned System is an implementation tool. It includes numerous principles and suggestions on the handling of lessons. Section G provides theories on Organizational Learning. These theories suggest that certain handling methods will promote organizational learning. Section H provides a summary.

B. DEFINITIONS

Learning is the act of gaining knowledge or understanding by study, instruction or experience.[12] Included as part of learning by experience is learning by trial-and-error.

[12] *Webster's Seventh New Collegiate Dictionary* (1972).

In cognitive learning circles, discovery learning refers to trial-and-error learning.[13] Learning is also defined as a relatively permanent change in behavior that results from experience.[14]

In general terms, a Lessons Learned System implies a system whose purpose is to create some behavior as a result of an experience or a lesson.

C. ARMY LESSONS LEARNED SYSTEM DOCUMENTS

The cognitive learning described above has been taking place for a long time. Expanding the process from individual learning to learning by a group or organization is also not new. What is relatively new is formalizing the process and creating a separate system within an organization to implement the process.

> One of the earliest and best known Lessons Learned System is the Center for Army Lessons Learned at Fort Leavenworth, Kansas, established in 1985.[15]

As a Lessons Learned System, the Center for Army Lessons Learned strives to change Army behavior in a positive way.

> Changes to behavior may result in either stopping something we have been doing, doing something different from before, or doing something new that we have not done before.[16]

The goal is to help soldiers and units perform their mission right the first time, regardless of the mission.[17]

> The old saying 'Live and Learn' must be reversed in war, for there we 'Learn and Live'; otherwise, we die.[18]

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[13] Vander Zanden, J. W. & Pace, A. J. (1984), page 177.

[14] Ibid., page 589.

[15] Snider, K. F., Barrett, F. J., & Tenkasi R. (2002).

[16] *CALL Handbook 97-13* (1997).

[17] Ibid.

[18] U.S. War Department Pamphlet No. 20-17, July 1945.

This is the ultimate goal.

The above guiding philosophy of the Center for Army Lessons Learned supports the literal interpretation of a Lessons Learned System. A Lessons Learned System strives to mold behavior of the organization or group it serves. The new behavior is based on a learning experience and it is expected that the change will be positive.

The Center for Army Lessons Learned uses a system outlined in Army Regulation 11- 33. This regulation establishes a system for the collection, analysis, dissemination, and implementation of combat, training, and materiel testing experiences with associated combat relevant lessons learned into Department of the Army (DA) doctrine, organization, research, development, acquisition, training, planning, and other appropriate activities.[19]

A Lessons Learned System has tasks that must be accomplished to achieve its goals. Army Regulation 11-33 has provided a listing of these tasks. The first task is to collect lessons or experiences. The second task is to analyze the experiences. During the analysis phase, the raw data of observations gets processed into lessons through an expanded interpretation method that includes feedback from experts around the Army.[20] The third task is to disseminate the lessons of the experiences to places where the behavior is suggested to be changed. The final task is to change the behavior through implementation.

Army Regulation 11-33 also provides definitions. It defines a lesson learned as validated knowledge and experience derived from observations and historical study of military training, exercises, and combat operations.[21] It does not specifically define validate. In general, to validate is to confirm the validity, where validity is the quality or state of being valid, where valid is having a conclusion correctly derived from

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[19] *Army Regulation 11-33*, Section 1.1 Purpose.

[20] Wizner A. (2001), page 48.

[21] *Army Regulation 11-33*, Glossary.

premises.[22] This is an important function of a Lessons Learned System. This is probably the most intellectually demanding function of a Lessons Learned System. It requires seeing the general in the specific. Another defined term is observation. Observation is raw information from any source that has not been refined through analysis. It can be either positive or negative.[23] In this definition there is an expansion of learning from mistakes to learning from mistakes and successes.

The Army regulation glossary does not specifically define a Lessons Learned System but does expand its functions beyond that of collecting, analyzing and disseminating. Its functions also include maintaining and managing an automated system of the experiences and lessons. This would support archiving for future reference, a responsibility of the Commanding General, U.S. Army Training and Doctrine Command. It is also tasked with determining methods of dissemination.

D. DEPARTMENT OF ENERGY DOCUMENTS

Another organization that has a well-developed Lessons Learned Systems is the Department of Energy. The Department of Energy Lessons Learned System is guided by a standard. The standard is DOE-STD-7501-99, The DOE Corporate Lessons Learned Program, December 1999. The following section summarizes information from DOE – STD-7501-99.

Under the Department of Energy, there are many diverse projects, programs and operations. These activities take place at many different places. A number of Department of Energy rules and requirements require that lessons learned be identified, evaluated, shared, and incorporated into projects, programs, or operations. These lessons learned were mostly kept local and not an integral part of the Department of Energy complex. In 1994 a Process Improvement Team of Department of Energy and contractor

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22 *Webster's Seventh New Collegiate Dictionary* (1972).

23 *Army Regulation 11-33*, Glossary.

personnel was tasked to develop a technical standard to provide direction on how to develop Lessons Learned Programs. DOE-STD-7501-99 was the result of their work.

The purpose of a Lessons Learned System from this standard is to share and use knowledge derived from experience to: 1) promote the recurrence of desirable outcomes, or 2) preclude the recurrence of undesirable outcomes. The standard defines a lesson learned as a good work practice or innovative approach that is captured and shared to promote repeat application. A lesson learned may also be an adverse work practice or experience that is captured and shared to avoid recurrence. These defining aspects of the Department of Energy Lessons Learned Program are consistent with aspects of the Center for Army Lessons Learned. Both pursue behavioral change that will have positive effects and both recognize that lessons or experiences that will be used to direct behavior can be positive or negative.

The standard identifies two basic processes. The first is considered the developmental process. This includes identification, documentation, validation and dissemination. These are actions that a Lessons Learned System would perform. The second is considered a utilization and incorporation process. These are actions that users of the system would partake in. These include identifying applicable lessons learned, distributing to appropriate personnel, identification of actions that will be taken as a result of the lessons learned, and follow up actions to ensure the appropriate actions were taken. The Department of Energy Lessons Learned System is meant to unite the many local Lessons Learned Systems that exist under its cognizance. The first process would be specific for the Headquarters Lessons Learned System and the second process would be for the local Lessons Learned Systems.

Another definition in the standard is causal analysis. A causal analysis is a review of an activity to determine the root cause, to identify less than adequate contributing systematic factors, to prevent further concerns. This is part of the validation process. Many approaches are available for identifying root causes. One of the most effective

tools is a cause-and-effect analysis. There are several techniques including Ishikawa's Fishbone Diagram and Goldratt's Thinking Process.[24]

Another result of the Process Improvement Team of Department of Energy and contractor personnel was the formation of the Society for Effective Lessons Learned Sharing. The Society's mission is to promote the process of identifying, sharing, and utilizing lessons learned from experiences within the DOE complex and outside in order to improve the safety, efficiency, and effectiveness for all Department work processes.[25] The Society publishes Fact Sheets on its website designed to help Lessons Learned professionals implement and improve lessons learned programs.[26] The Screening Lessons Learned for Site Applicability Fact Sheet includes a flowchart outlining a decision process for handling lessons learned from outside a local organization. Although specific to local Department of Energy sites, it suggests a validation criteria for lessons learned received from outside an organization. The criterion is that lessons learned pertaining to similar activities, hazards or equipment that exist at the local site should be candidates for dissemination and action if appropriate. Lessons that are not similar should be archived for future reference. The archiving of lessons learned, including those not disseminated for future reference, is a shared characteristic with the Center for Army Lessons Learned.

E. LESSONS LEARNED SYSTEM DECOMPOSITION

Another organization involved with Lessons Learned Systems is the American Association for Artificial Intelligence. Founded in 1979, the American Association for Artificial Intelligence is a nonprofit scientific society devoted to advancing the scientific understanding of the mechanisms underlying thought and intelligent behavior. The American Association for Artificial Intelligence activities include organizing and

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[24] *The Metrics Handbook* (1995).

[25] Society for Effective Lessons Learned Sharing Homepage, http://tis.eh.doe.gov/ll/sells/

[26] Ibid.

sponsoring conferences, symposia, and workshops.[27] One workshop was on Intelligent Lessons Learned Systems.[28] In the Call for Papers, a Lessons Learned System is described as follows: Lessons learned (LL) systems capture and store experiential knowledge for reuse in subsequent decision-making tasks.[29]

The following section summarizes information from Aha, D. W. (2000) on "intelligent lessons learned systems."

A lecture was presented at the Department of Energy Society for Effective Lessons Learned Sharing Spring 2000 Meeting. It included observations on the Lessons Learned process and a characterization of Lessons Learned Systems. Knowledge management is a business movement that promotes knowledge creation, sharing and leveraging within an organization to maximize business results. In an environment of financial constraints and loss of organizational knowledge there is a need to develop a culture of knowledge sharing. This requires a tool to capture, leverage and reuse knowledge.

A lesson is a validated record extracted from a (positive or failure) experience with a previous decision process that others in an organization can reuse to reinforce a positive result and/or avoid a failure. A lesson learned is a change resulting from applying a lesson that significantly improves a targeted process. A Lessons Learned Process implements a strategy for eliciting, retrieving, and reusing lessons obtained from experiential knowledge to continually support an organization. And a Lessons Learned System is a software system that supports a Lessons Learned Process.

There is an evolution in the definitions of lesson and lesson learned. The Center for Army Learned Lessons definition for lesson learned was a collection and validation of experiences. The Department of Energy Lessons Learned Program included the above for lesson learned but also included the sharing of the experience. Aha, D. W. (2000)

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[27] American Association for Artificial Intelligence Homepage

[28] Chaired by Dr. David W. Aha of the Naval Research Lab and Dr. Rosina Weber of Drexel University, took place on 31 July 2000 in Austin, Texas

[29] Intelligent Lessons Learned Systems Workshop, Objectives

expanded the definition even more to include the above but included the organization's behavior being changed as a result. The Aha, D. W. (2000) definition of lesson incorporated the less expanded Army definition of lessons learned. The Aha, D. W. (2000) lessons definition included the positive and negative and is consistent with the Army and Department of Energy practice.

The definitions also provide a new thought in the definition of Lessons Learned System. Aha, D. W. (2000) moves the former definitions of Lessons Learned Systems into Lessons Learned Process and promotes the software (possibly implied hardware also to mean computer system or information technology) system to mean the Lessons Learned System. The use of an automated system may be more of a requirement than a luxury and the lecture redefining may be in order. By the mid 1990's, the Center for Army Lessons Learned existing lessons learned process had been overwhelmed with the amount of data that it was collecting; it therefore sought to leverage Information Technology as a possible solution.

> The automation of the collection process proved invaluable … to support all of the organizations key functions.[30]

This implies that a quality of a Lessons Learned Systems (generally defined) is the pragmatic need to incorporate modern information technology.

Aha, D. W. (2000) also provides a more formal characterization of Lessons Learned Systems. The method provides a characteristic and a qualitative value for the characteristic. For example, a characteristic of a Lessons Learned System may be size. The qualitative values associated with size may be large through small. There were six characteristics. The characteristics are Contents, Organizational Type, Process Type, Target Process Relation, Dissemination Type and Recommendation.

The characteristic Contents describes the products of the Lessons Learned System. The qualitative values are pure or hybrid where hybrid may be a collection of lessons, alerts or best practices. A pure Lessons Learned System would only include

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[30] Wizner A. (2001), page 19.

lessons while a hybrid Lessons Learned System may also include information that would not be classified as a lesson. The distinction between qualitative values is not black and white as lessons may include positive experiences that some would classify as best practices.

The characteristic Organizational Type describes the organization that the Lessons Learned System is meant to serve. The qualitative values are adaptable through rigid. An adaptable organization is able to change its processes and work habits with relative ease. The reason for this relative ease could be that mechanisms exist to implement change or that the workforce is open to self-improvement. A rigid organization is one that is not readily changed. The reasons for this could be that there are many review processes before processes could be changed or that the culture of the organization is such that change is not easy.

The characteristic Process Type describes the subject of the lessons. The qualitative values are managerial, planning and technical. An example of a managerial lesson would be that a delivery from company A is always two weeks later than promised so that the order should be placed two weeks earlier to receive the shipment "on time". The lesson is applicable to one person, the person making the order. A planning lesson is more complex and involves many decision makers. An example of this would be a political or military campaign. A technical lesson involves product design, construction, test or maintenance. A technical lesson is also a tactic, technique and procedure for operational military forces.

The characteristic Target Process Relation describes how a Lessons Learned System is integrated with the organization. The qualitative values are standalone and embedded. A standalone Lessons Learned System relies on user initiative to populate the system with lessons. An embedded Lessons Learned System is integral with an organization's operations. Operational procedures require that lessons be recorded and entered into the system.

The characteristic Dissemination Type describes how lessons are distributed. The qualitative values are passive and active. A passive Lessons Learned System relies on

users seeking lessons from the system. An active Lessons Learned System determines who the appropriate users are and sends the lessons to them for review or implementation.

The characteristic Recommendation describes user's authority. The qualitative values are browsable and executable. For browsable, the user can only view recommendations. For executable, the user can execute recommendations.

The characteristics are not a complete list of possible characteristics but provide a possible framework for characterizing Lessons Learned Systems. The framework is a set of characteristics and qualitative values for those characteristics.

Aha, D. W. (2000) also provided a suggested list of characteristics that may be best for a Lessons Learned System. These suggestions included that a Lessons Learned System have a Target Process Relation of embedded. Another recommendation is that the Lessons Learned System have a Dissemination Type of active. This was expanded to include that the information technology serve the user and that the user need not be proficient in the operation of the information technology. The last characteristic suggested was that the Recommendation characteristic be executable or that the users have the option to implement the lesson learned.

It is asserted by Aha, D. W. (2000) that standalone (not embedded), passive (not active), browsers (not executable) do not promote knowledge sharing. The reasons are due to system issues (not well integrated with other organizational processes), information issues (lessons not well defined) and unrealistic user assumptions (users know about Lessons Learned System and how to use it, and user can correctly interpret lesson).

The process of characterizing Lessons Learned Systems was further refined in an Acquisition Review Quarterly article. The following section summarizes information from Snider, K. F., Barrett, F. J., & Tenkasi R. (2002).

Using Aha, D. W. (2000) as a basis, the characteristics can be grouped into one of three categories. The categories are Lesson, Operational and Organizational. It was

suggested that the best choices of characteristics for an organization's Lessons Learned System should be based on the social, political and organizational learning characteristics of the organization.

Table II-1 summarizes the refinement with specific explanation following.

Table II-1 Lessons Learned System Characteristics		
Group	**Characteristic**	**Quantitative Values**
Lesson	Content	pure, hybrid
	Process Type	technical, administrative, planning
Operational	Access	open, closed
	Formality	formal, ad hoc
	Locus	centralized, distributed
	Process Relation	embedded, standalone
	Acquisition	active, passive
	Handling	rigorous, open
	Dissemination	active, passive
Organizational	Interpretive Context	high, medium, low
	Type	adaptable, rigid

In the paper, the Lesson group contains the characteristics Content and Process Type. These characteristics are the same as presented in the lecture previously described. The qualitative values are the same. This group describes the nature of the lessons.

The next group is the Operational group. This describes how the Lessons Learned System operates. The characteristics are Access, Formality, Locus, Process Relation,

Acquisition, Handling and Dissemination. The Process Relation characteristic is the same as the Target Process Relation characteristic of the lecture. The Dissemination characteristic is the same as the Dissemination Type of the lecture.

The characteristic Access describes the extent that those outside the organization may use the organization's Lesson Learned System. The qualitative values are open and closed. An open Lessons Learned System may be used by anyone. Use is not limited to those in the organization. Closed means that the Lessons Learned System is for organizational use only.

The characteristic Formality describes the extent to which procedures and processes are established. The qualitative values are formal and ad hoc. A formal Lessons Learned System has documented procedures and processes for its operation. These operations could be for collecting, validating, disseminating and implementation monitoring to list a few. An ad hoc Lessons Learned System allows the facilitators to decide any method at any time.

The characteristic Locus describes the organizational structure. The qualitative values are centralized and distributed. A centralized Lessons Learned System relies on one "office" or location to be the center for lessons learned and all that goes with it. A distributed Lessons Learned System has many local offices that are performing lessons learned activities for a local part of the organization.

The characteristic Acquisition describes how lessons are obtained. The qualitative values are active and passive. An active Lessons Learned System seeks out lessons. This can be incorporating itself into the organization's operations or scanning outside Lessons Learned Systems. A passive Lessons Learned System relies on unsolicited submission of lessons.

The qualitative values are rigorous and open. A rigorous Lessons Learned System implies significant control through some review and approval process. These processes could determine if the interpretation of the experience is correct, it could determine if the lessons learned is appropriate for dissemination and it could also rewrite

the lesson to meet a certain form or writing standard. An open Lessons Learned System has little or no evaluation.

The Handling characteristic is the focus of this thesis. The Handling characteristic is examined for existing Lessons Learned Systems and its implication on the effectiveness of the system with regard to the tasks of a Lessons Learned System.

The Organizational group contains the characteristics of the organization that the Lessons Learned System is serving. The characteristics are Interpretive Context and Type. The Type characteristic is the same as the Organization Type characteristic of the lecture.

The Interpretive Context characteristic refers to the extent to which members of an organization share similar knowledge, backgrounds, and experiences. This commonality means that communication is easy within the organization. The qualitative values are high, medium and low. An organization with high Interpretive Context "speaks the same language" and is able to communicate with one another without an "interpreter".

The paper also suggested some possible consequences of designing a Lessons Learned System with certain qualitative values of a characteristic. With regard to the Handling characteristic, a rigorous Lessons Learned System may reduce participation. Processes of review, editing, validation, and approval may become so burdensome that organizational members lose interest in submitting lessons. An open Lessons Learned System may become populated with lessons that contain unsubstantiated opinions, controversial findings or self-serving claims.

F. KNOWLEDGE MANAGEMENT

> Like water, this rising tide of data can be viewed as an abundant, vital and necessary resource. With enough preparation, we should be able to tap into that reservoir -- and ride the wave -- by utilizing new ways to channel raw data into meaningful information. That information, in turn, can then become the knowledge that leads to wisdom.[31]

This is indicative of the mood that prevailed in the business world in 1995.

The development of information and communication technology allows data to be abundantly available. The Internet created a new business channel.

> The enhanced speed and capacity of communication has enabled the existence of a global market for many industries and business sectors.[32]

Consumers could access goods and services from their homes. Manufacturing companies could search for resources on a global scale.

Internally, companies are taking advantage of technology to retain data.

> Rapid changes in both personal computer technology and electronic communications during the past decade have given us the ability to create, gather, manipulate, store, and transmit much more data and information than ever before.[33]

With so much data available and with the potential that goes with it, it is not surprising that management has focused attention upon it. This focus is called knowledge management.

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[31] Alberthal, Les (1995)

[32] Chase, R.L. (1998).

[33] Chase, R.L. (1998) & Sistla, M., & Todd, J. (1998).

> Knowledge management is the systematic process of finding, selecting, organizing, distilling and presenting information in a way that improves an employee's comprehension in a specific area of interest. Knowledge management helps an organization to gain insight and understanding from its own experience.[34]

There is not one universally accepted definition for knowledge management but definitions from various sources are similar.

> Knowledge management involves the identification and analysis of available and required knowledge, and the subsequent planning and control of actions to develop knowledge assets so as to fulfill organizational objectives.[35]

> Knowledge management is the process through which organizations generate value from their intellectual and knowledge-based assets.[36]

> For CorpEd.biz, knowledge management is a strategy that turns an organization's intellectual assets -- both recorded information and the talents of its members -- into greater productivity, new value, and increased competitiveness. It teaches corporations, from managers to employees, how to produce and optimize skills as a collective entity.[37]

Implementing a knowledge management effort is sound business strategy. Benefits include an increase in the speed that an organization learns. Proper knowledge management will transform data into knowledge and foster smart business decisions. It will minimize the risk of making bad business decisions caused from the use of too much or the wrong kind of information.[38]

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[34] FAQ

[35] AIAI (2002)

[36] CIO (2002)

[37] Murray, P.C.

[38] Peters, R.F. (1997).

There are some principles associated with knowledge management.[39] Knowledge originates and resides in people's minds. Knowledge sharing requires trust. Technology enables new knowledge behaviors.

> Knowledge management started in most companies as the creation and use of electronic repositories.[40]

Knowledge sharing must be encouraged and rewarded. Management support and resources are essential. Knowledge initiatives should begin with a pilot program. Quantitative and qualitative measurements are needed to evaluate the initiative. Knowledge is creative and should be encouraged to develop in unexpected ways.

There are many terms or concepts that are used within the subject of knowledge management. One such concept is that of corporate memory or institutional memory.

> There is an increasing industrial interest in the capitalization of know-how of (geographically) dispersed groups of people in an organization. This know-how may relate to problem solving expertise in functional disciplines (e.g., design, testing production), experiences of human resources, and project experiences in terms of project management issues (e.g. social and organizational aspects related to the project team), design technical issues (e.g. design rationales, history of solution space explored, concurrent engineering techniques), and lessons learned.[41]

> A sample of the different activities that may take place under the umbrella of knowledge management is the development of a database of best practices and/or lessons learned from failed projects.[42]

Lessons learned and Lessons Learned Systems are a component of knowledge management.

Although the leading authorities do not always specifically address Lessons Learned Systems in their writings, there is some attention paid to data collection and

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[39] Davenport, T.H. & Prusak, L. (1998).

[40] Davenport, T (1999).

[41] Workshop (1996).

[42] Abram (1997) and Broadbent (1998).

information of a pragmatic nature that could be applicable to the functioning of a Lessons Learned System.

> Too much information is almost as bad as not enough. You have to identify what's relevant, important and effective.[43]

This suggests that a filtering on lessons learned may be appropriate. This filtering may take place in terms of collecting the lessons learned or disseminating the lessons learned.

> Managers have come to rely heavily on the computer's information. And you cannot put into the computer data that you don't have. Both executives and students think you tell the computer to get the data, and the computer gets it –no. You have to get it yourself.[44]

This may be applicable to the method of lessons gathering. The collection of lessons learned of a process should be embedded in the implementation of the process in lieu of gathering lessons learned after the fact or in a passive manner.

> Asking them to record the lessons they've learned during a hard day's work, or to spend extra time searching through an extensive repository before undertaking an important task, is unlikely to meet with a great deal of success. Instead, knowledge management has to be "baked into" the job. It's got to be part of the fabric of the work to import knowledge when it's needed and export it to the rest of the organization when it's created or acquired.[45]

In the opening paragraph of this section, the evolution to wisdom was suggested. Data is collected and transformed into information that is transformed into knowledge that is transformed into wisdom. A better word for wisdom might be behavior or actions based on the knowledge. In the small slice of knowledge management that is Lessons Learned Systems, the evolution from data to knowledge could be considered the Handling characteristic.

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[43] Murray, P.C. (2000).

[44] Drucker, P. (1997).

[45] Davenport, T. (1999).

Knowledge management provides some information on the terms data, information, knowledge and behavior.[46] Data are raw facts having no meaning of their own. Information is tangible representation of data within a specific context. Knowledge is the individual context on an individual's role, learning behavior and experiences. Behavior is decisions that result in action.

> We had two decades which focused solely on data processing, followed by two decades focusing on information technology, and now that has shifted to knowledge. There's a clear difference between data, information, and knowledge. Information is about taking data and putting it into a meaningful pattern. Knowledge is the ability to use that information.[47]

This is a reasonable goal for the Handling characteristic of a Lessons Learned System. The goal is to take experiences and transform them into a form that can have meaning and be of use to the organization that the Lessons Learned System serves.

Knowledge management also provides some qualities that make information valuable.[48] The qualities are accuracy (inspires confidence), timeliness (appropriately current), accessibility (can be readily located when required), engagement (capable of making an impact and/or influencing a decision), application (relevant and useful within the defined context) and rarity (possibly provides a hitherto unknown or confidential insight). In terms of applicability to a Lessons Learned System, all of these could be desired qualities. In terms of the Handling characteristic of a Lessons Learned System, most of these qualities could be used to determine if a lesson learned should be disseminated. The relevant qualities would be accuracy, timeliness, engagement, application and rarity.

Another view on adding value to create meaningful information is to customize the data, categorize it, perform calculations, make corrections to and condense it. Also to

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[46] Abram, S. (1997a).

[47] Blue, A. (1998).

[48] Davenport, T.H. & Prusak, L. (1997).

make knowledge more useful, it is suggested that a comparison be provided and possible consequences be determined.[49]

Knowledge management also provides suggestions for processing data so that it can be absorbed, applied and acted upon.[50] The first is pruning. Eliminate the obsolete, the irrelevant and the inaccurate. The second suggestion is adding context through summary, analysis, comparison, synthesis and conclusion. The third suggestion is enhancing style through effective variation and interactivity, creative staging and inspirational dramatization. The final suggestion is choosing the right medium for presentation. There are a number of possibilities for this including an Intranet, phone calls, and E-mails. The first two suggestions and possibly the third may be applicable to the Handling characteristic of a Lessons Learned System. The last suggestion would be applicable to the Dissemination characteristic.

Knowledge management also provides some guidance for the Acquisition characteristic for a Lessons Learned System with respect to the qualitative value of active. It suggests the data sources of the press and other media, networking with friends, associates and colleagues, industry publications and organizational meetings. It also suggests continuing educational opportunities, competitors or other players in the market and any number of other internal, external, formal and informal information sources.[51] The reasonableness of these suggestions would depend on the nature of the organization that the Lessons Learned System serves but should not be discarded outright.

> These activities and others constitute a vital activity know as 'environmental scanning', an activity which no organization, regardless of its size, product or market position can afford to ignore.[52]

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[49] Davenport, T.H. & Prusak, L. (1998).

[50] Davenport, T.H. & Prusak, L. (1997).

[51] Choo, C.W. (1998).

[52] Ibid.

G. ORGANIZATIONAL LEARNING

> The key purpose of information: to inform people.[53]

Knowledge management goes beyond this, striving to change organizational behavior as a result of this knowledge. Changing organizational behavior is not a simple task and a branch of knowledge management has concentrated on factors effecting the change of organizational behavior. That branch, interestingly enough older than knowledge management, is organizational learning.

> Organizational learning, for example, is increasingly being drawn into the knowledge management fold.[54]
>
> Knowledge management is about enhancing the use of organizational knowledge through sound practices of information management and organizational learning.[55]

The transformation of data to information to knowledge has no value unless the knowledge is used to guide organizational decisions and practice. Sometimes this knowledge suggests organizational decisions and practices that are a significant change to the organization, not uncommon in the modern fluid business world. Organizations, being of large mass, so to speak, have momentum such that change is not always easy. This has increased the attention given to theories of organizational learning.

In 1966 Michael Polanyi made the distinction between explicit knowledge, which can be articulated in formal language and transmitted among individuals, and tacit knowledge, personal knowledge embedded in individual experience and involving such intangible factors as personal belief, perspective, and values.[56] Within tacit knowledge is the knowledge that is valuable to an organization and would benefit the organization if it

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53 Davenport, T.H. & Prusak, L. (1997).

54 Davenport, Thomas (1999).

55 Broadbent, M. (1998).

56 Polanyi, Michael (1966).

were transferred to others in the organization. This would be for use or future use. However, tacit knowledge is not readily transferable as is explicit knowledge, particularly between geographically separated regions of an organization.

> Perhaps the world's most recognized authority on knowledge in the organization is Ikujiro Nonaka. In his groundbreaking book The Knowledge-Creating Company (with co-author Hirotake Takeuchi), he laid out a model of how organizational knowledge is created through four major processes: socialization, externalization, combination, and internalization.[57]

By the creation of knowledge it is meant that knowledge is transferred from one in the organization to others; thus the knowledge exists in more people and is in a sense created.

Socialization is the process where tacit knowledge is transferred as tacit knowledge between individuals.[58] This is accomplished in a "Ba" (Japanese signifying place, arena or field), more precisely an "Originating Ba where individuals can share feelings, emotions, experiences and mental models."[59]

Externalization is the process where tacit knowledge is converted to explicit knowledge.[60] This is accomplished in an Interacting Ba. An example of this is selecting the people with the right mix of knowledge and capabilities for a specific mission, like a task force, an urgent project team, or a cross-functional team.[61]

Combination is the process where explicit knowledge is transferred as explicit knowledge and absorbed as explicit knowledge.[62]

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[57] Nonaka I. (1997).

[58] Malhotra, Y. (1997).

[59] Nonaka, I. (1997).

[60] Malhotra, Y. (1997).

[61] Nonaka, I. (1997).

[62] Malhotra, Y. (1997).

> To support the process of knowledge combination, Nonaka suggests a Cyber Ba. At this point in the process of organizational knowledge creation, the relevant knowledge has been captured and represented in a way that does not demand face-to-face human interaction to share. The place for combination, therefore, can be in the virtual world, using information technology to transcend the limitations of time and space.[63]

This aspect of knowledge creation is supported by Lessons Learned Systems. In these systems, explicit knowledge is transferred between members of an organization, often by virtual world means.

Internalization is the process that involves conversion from explicit knowledge to tacit knowledge.[64] Nonaka suggests this take place in an Exercising Ba.

> Here, the knowledge process being supported is internalization, in which an individual learner makes someone else's knowledge his or her own.[65]
>
> Key to the model is Nonaka's assertion that none of these processes is individually sufficient; all must be present to fuel one another. In fact, Nonaka has always said, it is only when all four processes interact that the organization can enjoy a "spiral" of knowledge creation – and profitable innovation.[66]

Although a Lessons Learned System is most obviously part of the Combination process, consideration should be given in its design and procedures for use that support the other processes. For example, the Handling characteristic of a Lessons Learned System should prepare lessons learned so that not only Combination occurs but also initiates Internalization within the receiver of the lesson learned. This would more fully support Nonaka's model of organizational learning.

Another model in organizational learning is the Theory of Action. In this theory, developed by Chris Argyris and Donald Schon, members of an organization have a dual nature. One nature is to make decisions and take actions based on a theory-in-use.

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63 Nonaka, I. (1997).

64 Malhotra, Y. (1997).

65 Nonaka, I. (1997).

66 Ibid.

> Theories-in-use govern actual behavior and tend to be tacit structures. Their relation to action is like the relation of grammar-in-use to speech; they contain assumptions about self, others and environment – these assumptions constitute a microcosm of science in everyday like.[67]

The other nature is to hold those theories espoused when asked to speak of our actions to others. This is called espoused theory. Argyris makes the case that effectiveness results from developing congruence between theory-in-use and espoused theory.[68]

This may have some application to a Lesson Learned System in the sense that management may state that they want lessons learned on one hand but require the submitter to process a large and difficult amount of paperwork.

The modeling of organizational learning continues with the concept of single-loop and double-loop learning. For Argyris and Schon, learning involves the detection and correction of error.[69]

> In single-loop learning', the detection and correction of organizational errors permits the organization to carry on its present policies and achieve its current objectives.[70]

An example of single-loop learning might be the problem of maintaining enough coal in a firebox. A single-loop solution would be to shovel coal in faster.

Double-loop learning occurs when error is detected and corrected in ways that involve modification of an organization's underlying norms, policies and objectives.[71]

A double-loop solution to the coal problem might be to increase efficiency by adding insulation on the firebox or reduced temperature requirements or heat loads.

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67 Argyris C. (2001).

68 Ibid.

69 Argyris C. (2001).

70 Argyris, C., and D. A. Schön. (1978).

71 Ibid.

> Double-loop learning is necessary if practitioners and organizations are to make informed decisions in rapidly changing and often uncertain contexts.[72]

The modeling continues by characterizing organizations that would likely exhibit single-loop learning (Model I) and double-loop learning (Model II).[73] There may be some consequences with regard to Lessons Learned Systems. Model I members are defensive and do not wish to be seen as incompetent. This attitude would not be consistent with submitting lessons learned.

The goal of this model on organizational learning is to transform organizations into Model II organizations such that double-loop learning will occur. There is a strategy for accomplishing this and relies on maximum participation of clients, minimizing the risks of candid participation and starting where people want to begin.[74] One aspect that may be applicable to Lessons Learned Systems is to implement group participation in the design of the Lessons Learned System.

The above represents a summary of the major thinkers in the areas of knowledge management and organizational learning. There is applicability to a Lessons Learned System and particularly to the Handling characteristic. The applicability is as follows.

A Lessons Learned System supports the Combination process of Nonaka's organizational learning model. It is the transfer of explicit knowledge. However, new knowledge begins with tacit knowledge and must be converted to explicit knowledge to be transferred, except perhaps in close local environments. Nonaka suggests project or cross functional teams for this transfer while Drucker espouses the virtues of being proactive and Davenport suggests an embedded process for obtaining explicit data. In terms of the Handling characteristic it would appear that handling should occur as close to the experience source as possible, both in terms of time and distance.

Multiple authors suggest that the converted explicit knowledge be of appropriate form. Murray calls for the knowledge to be relevant, important and effective. Blue states

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[72] Argyris C. (2001).

[73] Ibid.

[74] Ibid.

that the knowledge should have meaning to the user. Davenport and Prusak advise that the knowledge should be accurate, timely, applicable and capable of influencing a decision. Davenport and Prusak also advise eliminating the obsolete and adding context. Nonaka provides that the knowledge should eventually be used to develop tacit knowledge in the receiver. For the Handling characteristic, this suggests major involvement from the birth of the experience to dissemination.

Argyris professes that users should participate in the design. Although probably not his intention, this could be interpreted as the receivers participating in the design of the final form (the product of the Handling characteristic) as it is being developed. As the lesson learned is being developed, before dissemination, the eventual receiver provides input, in an iterative fashion with the source of the experience, to make the lesson learned more relevant and useful.

H. SUMMARY

The Center for Army Lessons Learned has provided a list of tasks that are basic to a Lessons Learned System. They are: collect lessons or experiences, analyze the experience and disseminate the lessons to places where the behavior is suggested to be changed.

The Department of Energy has followed suit and has identified basic requirements of a Lessons Learned Systems. The requirements are that lessons learned be identified, evaluated, shared and incorporated into projects, programs and operations.

In order to better understand the operation of a Lessons Learned System and the role of environmental factors relating to the organization it serves and the nature of its lessons, defining characteristics of a Lessons Learned System have been proposed. These are summarized in Table II-1. Specifically there is the Handling characteristic.

Fueled by the development of computer networks and its accompanying ability to store and transfer information, a study of information transfer has developed entitled Knowledge Management. Under the subject of Knowledge Management resides Lessons Learned Systems. Knowledge Management has provided some basic principles that relate to the handling of lessons learned. These are included in Table II-2.

A basic goal of a Lessons Learned System is the implementation of lessons such that behavior is changed in a positive way. Changing behavior on an organizational scale is included under the subject of Organizational Learning. Organizational Learning theories suggest certain actions relating to the handling of lessons learned. These are also included in Table II-2.

Table II-2 Literature Principles that Relate to Handling of Lessons	
Author	**Statement**
Center for Army Lessons Learned	validate (conclusion correctly derived from premises) the lesson
Department of Energy	perform causal analysis to determine root cause of lesson
Murray, Phillip	filter lessons for relevancy
Drucker, Peter	information, you have to get it yourself
Davenport, Tom	performing work and asked to record lessons while doing so is unlikely to be successful
Blue, A.	transform information to knowledge
Davenport, Tom & Prusak, L.	customize data
Nonaka, I.	lessons should initiate the Internalization process
Argyris, Chris	management support and involvement
Argyris, Chris	users participate in process/design
Argyris, Chris & Schon, D. A.	root cause analysis (double loop learning)

The above provides the conceptual framework by which to evaluate the primary research question: How may a Lessons Learned System be characterized according to the handling of lessons processing, and how may such a characterization be applied to Lessons Learned System design or architecture?

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III. METHODOLOGY

A. INTRODUCTION

The purpose of this chapter is to describe the approach used to answer the primary research question: How may a Lessons Learned System be characterized according to the handling of lessons processing, and how may such a characterization be applied to Lessons Learned System design or architecture?

This section describes the overall methodology while the remaining sections provide more detail on the specific tasks of the methodology.

Chapter II has provided a framework for characterizing Lessons Learned Systems. A Handling characteristic has been defined.

Unfortunately, the literature review reveals there is some cloudiness concerning what a lesson is. The first task of the analysis will be to more precisely define lesson and therefore allow a starting point, in terms of time, when actions of a Lessons Learned System would be considered actions of Handling.

The qualitative values associated with the Handling characteristic are rigorous or open. However, this is not sufficient to characterize a Lessons Learned System according to the handling of lessons processing to the extent that the specifics of the rigorous value can be various. Therefore the rigorous value will be expanded into a rigorous set. The rigorous set will include the handling possibilities.

As it is possible that a Lessons Learned System will not incorporate all the possible rigorous methods, the rigorous set will include the ability to specify the existence of the method or its omission. This property allows the rigorous set to be renamed the rigorous variable set. As rigorous methods may be variable, the omission of all would indicate a qualitative value of open. The rigorous variable set is more appropriately named the Handling Variable Set.

The existence of a Handling Variable Set answers the first part of the primary research question: How may a Lessons Learned System be characterized according to the

handling of lessons processing?, in a more precise and encompassing manner. The specifics of the Handling Variable Set will be developed in Section E of this chapter and Chapter V.

Chapter II has also provided a list of tasks that are basic to a Lessons Learned System. They are collect lessons or experiences, analyze the experience or lessons to obtain knowledge and disseminate the knowledge to places where the behavior is suggested to be changed. These tasks can be reworded as receiving lessons, developing quality of lessons and disseminating to insure implementation.

On the subject of research methods,

> We start by carefully considering what it is we already know and thus what it is we need to find out about through research.[75]

Known are the tasks of a Lessons Learned system. What is not known is how the Handling Variable Set affects these tasks.

Obtaining this knowledge will allow the second part of the primary research question to be answered. The second part of the research question is: and how may such a characterization be applied to Lessons Learned System design or architecture? The method of determining this knowledge, the knowledge being the cause and effect relationship, is detailed in Section F.

The following sections provide the specific tasks of the methodology.

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75 Harvey, D. (2002).

B. REQUIRED DATA

The Handling characteristic of Lessons Learned Systems is not universal and is unique to each Lessons Learned System. In order to collect methods of handling and their effect, Lessons Learned Systems must be identified. Once these systems have been identified, a method of contact must be determined.

The extent of what a Lessons Learned System considers handling may also vary. Therefore information on the entire process is necessary to determine what potentially could be considered the Handling characteristic. This will provide development of the Handling Variable Set.

In order to determine how the Handling Variable Set may be applied to Lessons Learned System design or architecture, a number of pieces of information will be required. These include the purpose or goals of the Lesson Learned System, the present concerns, the consequential experiences of the utilized Handling characteristic and all other characteristics defined in Table II-1.

To summarize, every aspect of the Lessons Learned System and the organization it serves could have some relevancy; therefore as much information as possible on a particular Lessons Learned System and its organization will be obtained along with experiences from its operation.

C. DATA COLLECTION

The identification of potential Lessons Learned Systems was the starting point. The Internet provided a listing of existing Lessons Learned Systems.[76] The Web pages for these organizations were reviewed. An attempt was made to contact each organization about its Lessons Learned System. Most provided an e-mail address. In these cases, an e-mail was sent requesting that an attached questionnaire to the e-mail be

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76 Lessons Learned Links, http://www.aic.nrl.navy.mil/~aha/lessons/

filled out and returned. In cases where a phone number was also listed, an attempt was made to personally make contact with a Lessons Learned Systems person. Cooperation with the Lessons Learned System was successful in cases where personal contact was made.

The questionnaire was designed with questions related to the primary research question. Being that a project, be it design or a paper, is iterative in nature, the questionnaire was not ideal. The implementation of the analysis revealed the questionnaire's shortcomings. To counter this deficiency, e-mails and phone calls were used to collect additional data.

The questions on the questionnaire are listed below with the original intended purpose of the question in parenthesis. The information obtained sometimes provided an insight that was not originally envisioned.

The questions on the questionnaire were:

1. What is the purpose of the Lessons Learned System? (This was asked to find out about the Lessons Learned System. Answers to this question might answer questions such its function and overall integration into the organization.)

2. How are lessons obtained? (This was asked to collect information on events that lead up to the handling of the lessons and for general information. This provided information on the subject of the lessons.)

3. What degree of formality is used, if any, in validating the lessons learned? (Validating of the lessons was considered the main activity of handling and so this question was asked to obtain information on the nature of handling.)

4. Why was this degree of formality used? (This was asked to probe if there was a relationship between a very formal processing and the importance of the lesson.)

5. What is the validation process? (This was asked to obtain an understanding of the mechanics of the handling process.)

6. Has the Lessons Learned System been successful? Based on what evidence? (This was asked to provide a check that the method of handling based on the purpose of the Lessons Learned System was appropriate as indicated by success. The second part of the question was to reduce subjectivity.)

7. What are the consequences of disseminating an erroneous or misleading lessons learned? (This was to probe again if there was a relationship between a very formal processing and the importance of the lesson)

8. Is there a disclaimer associated with the Lessons Learned System? (This was to gauge the confidence of the Lessons Learned System in their handling methods in terms of disseminating accurate information.)

9. Is there a single person responsible for the accuracy of the Lessons Learned System? (This was to identify an additional contact person and gauge accuracy of the lessons. If there is not one person responsible then there is no one really responsible.[77])

Some organizations responded to the questionnaire. In all cases it should be understood that the answers to the questions are not necessarily the official answer or position of the organization.

Another method of obtaining information on existing Lessons Learned Systems was by direct contact where direct contact was feasible. Again, information obtained through direct contact is not to be considered the official policy of the organization.

D. DATA ORGANIZATION

The data received from the questionnaire supplemented by e-mails and telephone calls was used for a general write-up of each Lessons Learned System (see Chapter IV). In order to ease abstraction of relevant data from the write-ups, the data was organized into tables.

E. HANDLING VARIABLE SET

The development of the Handling Variable Set was based on empirical data. From the data on existing Lessons Learned Systems, the handling methods of each Lessons Learned System were listed in a table. From that table, common methods were combined and ordered in the logical time progression of actions of a Lessons Learned System. The order was: receiving lessons, analyzing lessons and finally actions related to

77 Admiral Rickover on requiring signatures on documents

dissemination. This list, representing the domain of handling methods, was used to create the Handling Variable Set.

This list, placed in a table, was transformed into a number. The number was a collection of binomial numbers. Each placeholder of the number represented a handling method. That is, the ones place represented a handling method, the tens place represented another handling method, the 100s place another, etc. A one in the placeholder represented that the handling method was employed, a zero meant that it was not used.

As an illustration of the method, consider a sample of three Lessons Learned Systems. It was identified, through a questionnaire, that Lesson Learned System 1 employed handling method A, Lessons Learned System 2 employed handling method B and Lessons Learned System 3 employed handling methods A and B.

The domain of handling methods would then be A and B. Since there are two, a two digit number would be used; A being represented by the tens place and B being represented by the ones place. A one is used to represent existence of the method and a zero is used to indicate omission.

Lessons Learned System 1 would then have a Handling Variable Set of 10 because it employs handling method A (indicated by a one in the tens place) and does not employ handling method B (indicated by a zero in the ones place). Lessons Learned System 2 would have a Handling Variable Set of 01 because it employs handling method B (indicated by 1 in the ones place) but does not employ handling method A (indicated by 0 in the tens place). Lessons Learned System 3 would have a Handling Variable Set of 11 because it employs both handling methods A and B (indicated by 1 in the tens place and a 1 in the ones place).

This coding allowed bulky qualitative data to be represented in a much-condensed form. It provided a method to accurately characterize or describe a handling method for any existing Lessons Learned System, at least within the database of Chapter IV and allowed quicker comparisons.

F. APPLICATION TO LESSONS LEARNED SYSTEM DESIGN

The approach taken was to determine what effects existing Handling Variable Set digit values had on the tasks of a Lessons Learned System. These tasks were the main tasks identified in Chapter II. These tasks were receiving lessons, quality of lessons learned disseminated and dissemination of lessons learned where dissemination included implementation.

This is a qualitative, empirical analysis. The tool or method used to provide the framework for this analysis is the influence diagram.

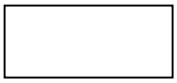
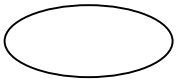
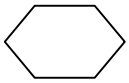
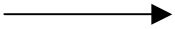
> The *influence diagrams* are used both as a means for communicating the model between various categories of "experts", further as an aid in accident analyses, and also in the qualitative evaluation.[78]

1. The Influence Diagram

An influence diagram is a graphical representation of the influences on some objective. Usually the objective is to maximize or minimize some attribute. The influences are identified, distinguished by symbol, as those that are controllable and those that are not.

[78] Hokstad, P.

Table III-1 identifies the symbols used and their meaning.

Table III-1 Influence Diagram Symbols		
Name	**Symbol**	**Meaning**
Rectangle		A decision, a variable that the decision maker has the power to control
Oval		A variable that is not controllable by the decision maker, an environment or chance condition
Hexagon		An objective variable, criterion that is to be maximized or minimized
Arrow		Denotes influence

2. Influence Diagram Variables

An influence diagram has one objective variable. The objective variables that are of interest to Lessons Learned System design are receiving lessons (maximize), the quality of lessons (maximize) and the implementation of lessons (maximize). There are three; therefore there will be three Influence Diagrams.

The decision variables are the choices that can be made that effect the objective variables. For our purposes, the decision variable of interest is the Handling Variable Set, as this relates to the second part of the primary research question. This is not to exclude other non-Handling characteristics that may effect the second part of the primary research question.

The environment or chance variables are those variables that the Lessons Learned System designer has no control over.

It is not necessary to provide a complete, all encompassing Influence Diagram. There is only a need for an Influence Diagram that contributes to answering the second part of the primary research question.

3. Determining the Influence Diagram

The determination of the influence diagram will be based on empirical data from Chapter IV.

The main method will be the use of commonality. An example would be all Lessons Learned Systems that experience success in one objective employ a certain handling method. Those that do not employ the handling method do not experience success. That handling method is then shown as a decision variable on the Influence Diagram.

The proposed theoretical suggestions for the Handling characteristic can then be used to support the findings and vice versa.

4. Example of Determining the Influence Diagram

In Section E, the method of determining the Handling Variable Set was illustrated. Lessons Learned System 1 had a Handling Variable Set of 10, Lessons Learned System 2 had a Handling Variable Set of 01 and Lessons Learned System 3 had a Handling Variable Set of 11.

Through use of a questionnaire and interviews it was revealed that Lessons Learned System 2 has a concern for receiving lessons while Lessons Learned Systems 1 and 3 did not have this concern. Comparing the Handling Variable Sets of the three, it can be seen that there is evidence that the tens place effects receiving lessons. A one in the tens place and there is no concern, a zero and there is a concern. From Section E, a one in the tens place represents implementation of handling method A.

An influence diagram can then be constructed with the Handling Variable Set of 1x (where x could be one or zero) as a decision variable (rectangle) and receiving lessons as an objective (hexagon). This cause and effect can then be substantiated by the literature review. The literature review may suggest that handling method A will promote receiving lessons.

5. Use in Lessons Learned System Design

Influence Diagrams can be used to determine if a proposed design or architecture, in terms of lessons handling, will be successful in the three main tasks that a Lessons Learned system must perform to be successful. The Handling Variable Set for the Lessons Learned system is determined and compared to the information listed in the Influence diagrams. An omission of a handling method may indicate potential problems in one of the tasks.

G. APPLICATION TO THE SUPSHIP GROTON LESSONS LEARNED SYSTEM

The method of characterizing the handling of lessons in a Lessons Learned System by the Handling Variable Set and the use of the Influence Diagrams to Lessons Learned System Design can be applied to the new, developing SUPSHIP Groton Lessons Learned System.

The approach will be to examine the present Handling Variable Set of the SUPSHIP Groton Lessons Learned System against the Influence Diagrams to predict performance in the areas of receiving lessons, quality of lessons learned disseminated and implementation of the lessons learned by SUPSHIP Groton. Where sub-performance is predicted, suggested changes to the method of handling lessons, which will change the Handling Variable Set accordingly to remove the sub performance prediction, will be made.

H. CONCLUSION

This chapter provided the methodology to answer the primary research question. It is an empirical, qualitative method based on the data of Chapter IV.

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IV. EXISTING LESSONS LEARNED SYSTEMS

A. INTRODUCTION

This chapter contains the data collected about existing Lessons Learned Systems. It also organizes the data in a form that supports the analysis methodology of Chapter III and is implemented in Chapter V.

To obtain information about Lessons Learned Systems, the Internet was the primary resource used. It provided a listing of Lessons Learned Systems.[79] From the list, organizations employing Lessons Learned Systems could be accessed. As detailed in Chapter III, information was then obtained through a questionnaire and/or an interview.

Section B contains write-ups on the existing Lessons Learned Systems based on a questionnaire and e-mail and telephone follow-up. Section C organizes the data in tables.

B. EXISTING LESSONS LEARNED SYSTEMS

The phrase existing Lessons Learned System represents a sample of Lessons Learned System and is not meant to represent all existing Lessons Learned Systems.

Some organizations responded to the questionnaire. In all cases it should be understood that the answers to the questions are not necessarily the official answer or position of the organization answering.

The organizations that responded were:

1. Canadian Army Lessons Learned Centre
2. The United Nations Peacekeeping Best Practices Unit (formerly The Lessons Learned Unit of the Department of Peacekeeping Operations)
3. American Industrial Hygiene Association (AIHA) Health & Safety Committee
4. U.S. Army Center for Engineer Lessons Learned
5. Army Medical Department Lessons Learned

[79] Lessons Learned Links, http://www.aic.nrl.navy.mil/~aha/lessons/

6. Coast Guard - Standard After Action Information and Lessons Learned System

7. Best Manufacturing Practices Program

8. Department of Energy Project Hanford Lessons Learned System

9. BNFL Incorporated Lessons Learned System

10. Department of Energy Headquarters Lessons Learned System

11. Department of Energy Office of Environmental Management Lessons Learned Program

12. Federal Transit Administration Lessons Learned System

13. International Space Station Lessons Learned Database

14. Mine Action Information Center Lessons Learned Database

15. Electric Boat Corporate Lessons Learned Database

1. Canadian Army Lessons Learned Centre[80]

> These responses are provided from my experience working in the Canadian Army Lessons Learned Centre, as well as the experience of others in the section, however the responses are not necessarily Canadian Army policy or direction. My comments are provided to you for background material on lessons learned organizations.[81]

Within the Canada National Defense exist the Land Force Doctrine and Training System Formation. At their headquarters in Kingston, Ontario is the strategic staff entitled Lessons Learned. This is the Canadian Army Lessons Learned Centre.

The purpose of the Lessons Learned System is to collect and analyze Canadian and Allied operational and training experiences for dissemination as Lessons Learned,[82] with a view to improving the overall operational capability of the Army. This includes efficiency of present operations and expanded operational capability through improved

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80 Twohey, Major. J. Mark, Canadian Army Lessons Learned Centre point of contact,(personal communication, e-mail questionnaire, January 22, 2002)

81 Ibid.

82 Canadian Army Lessons Learned Centre Web Page

technology such as bullet proof vests and warmer deep winter boots.[83] The three key activities are collect, analyze and disseminate. The ultimate purpose of the Lessons Learned Centre is to help promote positive change.

Lessons are obtained in several ways. Two primary methods are by (1) documented reports on training or operations and (2) visits to units on training and operation. The documented reports contain questions that are answered by the unit involved in the operation or training. The questions are general or broad so that the same questions can be used for different training or operation. This creates standard reports although there are different reports for training and operations. The training reports are shorter and completed after the exercise.

The operational reports are longer and are completed in two parts. Operations are divided into phases. Phase 1 is Warning, Phase 2 is Preparation, Phase 3 is Deployment, Phase 4 is Employment and Phase 5 is Redeployment. The first part of the operational report is for Phases 1, 2 & 3 and is submitted 6 weeks after deployment and covers activities that took place in Canada during these phases. The second part is to be completed 6 months at the end of the tour. The reason for their being two parts is that lessons captured in the early phases can be passed on to others without waiting for an operation to conclude and memories of the early phases are still fresh in the minds of the people completing the form.

Reports are sent up through the chain of command for comment, with information copies sent to the Lessons Learned Centre to keep them informed of the flow of information. One value of the standard form is that an issue can be tracked with respect to the forms that are received from different sources. The forms also include opportunity for the units to add miscellaneous comments.

The Lessons Learned Centre also visits exercises in Canada as well as deployed operations in order to stay up to date with what is happening in the field, and also to have a better perspective when reading the reports after the fact.

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[83] Young, Major J., Canadian Army Lessons Learned Centre point of contact, (personal communication, telephone, July 2, 2002)

The Canada Lessons Learned Centre defines four key events that apply to the lessons learned process:

1. Observation – An observation is a comment about an experience that occurred during an operation, training event or other activity. Observations provide the data upon which analysis is subsequently conducted.

2. Issue – An issue is a topic that develops from one or more related observations or recurring observations.

3. Lesson – The knowledge that is generated from the analysis of an observation to determine the underlying causes, the implications and which can subsequently be used to plan effective action.

4. Lesson Learned – A lesson learned is a lesson that, when assimilated, resulted in a tangible change in attitude, capability, behavior or process.

The reports then act as observations. The Canada Lessons Learned Centre then analyzes the observations to determine what actions are necessary. These actions could effect doctrine, training, acquisition of equipment and so forth. The Lessons Learned Centre does not implement these changes but advises authority as to reporting and change/implementation. The reports are the main vehicle to obtain lessons.

In terms of the formality used, this is viewed by the Lessons Learned Centre as follow up to direction on change defined as lesson learned. The Lessons Learned Centre states that this can be accomplished by several different functions, most importantly the chain of command.

> What is equally important to note, is that just because direction was passed on to implement change, it doesn't necessarily translate into action at lower levels, which brings me back to the importance of the chain of command in the process.[84]

The Lessons Learned Centre is not a command organization. The implementation of lessons learned is the present concern of the Lessons Learned Centre.[85]

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84 Twohey, Major. J. Mark, Canadian Army Lessons Learned Centre point of contact, (personal communication, e-mail questionnaire, January 22, 2002)

85 Young, Major J., Canadian Army Lessons Learned Centre point of contact, (personal communication, telephone, July 2, 2002)

Another point brought out with regard to the degree of formality is the issue of providing feedback to the people that proposed/documented the issue and to the people who are expected to implement the change. There is an importance to pass on feedback that lets people know that the issue/problem is acknowledged but cannot be changed at this time due to various limitations such as time, resources, personnel, etc.

Concerning the validation process, the Lessons Learned Centre states that the easy part of a Lessons Learned System is identifying what the problem is.

> While it is one thing to identify the deficiency, it is another step to get people to agree on the solution.[86]

The biggest challenge in a lessons learned organization is in "closing the loop". By "closing the loop" it is meant that decisions are made, direction passed on, and change is implemented. The Lessons Learned Centre provides questions that if answered will lead to "closing the loop".

1. What change might be suggested/recommended/considered?
2. Who can influence or initiate this change?
3. Who decides what change will be initiated (authority)?
4. Who decides who is responsible for the change?
5. Who decides when/how the change is to be done (limits/restrictions)?
6. Who has authority to follow-up and ensure the change takes place?

The Army Lessons Learned Centre has been successful.

> We believe we have been successful in helping advocate and implement change in the Army, however there will always be room for improvement. [87]

The consequences of disseminating an erroneous or misleading lesson learned would be poor information being passed to the field, with a resultant negative impact on the Lessons Learned organization and others involved in passing on the information.

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[86] Twohey, Major. J. Mark, Canadian Army Lessons Learned Centre point of contact, (personal communication, e-mail questionnaire, January 22, 2002)

[87] Ibid.

To avoid this there is a requirement to ensure that issues and lessons are legitimate and cover a broad perspective – that is to say they aren't influenced by a narrow application or a specific agenda by the author/initiator.[88]

There is no single person responsible for the accuracy of the Lessons Learned Centre. The Director of the Lessons Learned Centre is closely linked with the chain of command both in the reporting and the change/implementation. The Director has responsibilities to the Commander of the Army regarding the Lessons Learned Centre. As a staff advisor, the Director does not have authority to direct and implement change unilaterally. The Army Lessons Learned Process involves more that just the Army Lessons Learned Centre.

2. The United Nations Peacekeeping Best Practice Unit[89]

The United Nations Peacekeeping Best Practices Unit was formerly called The Lessons Learned Unit of the Department of Peacekeeping Operations.

The Lessons Learned Unit of the Department of Peacekeeping Operations at the United Nations was created in 1995. Its personnel consisted of a Head of the Unit, a Coordination Officer, two Military Officers, two Research Analysts, a Research Assistant and an Administrative Assistant.[90]

The purpose or objectives of the Lessons Learned Unit is to draw lessons learned from peacekeeping missions. It is to recommend the application of lessons learned from peacekeeping missions to ongoing and future operations. It is to monitor the application of these recommendations and lessons learned. It is to develop the Lessons Learned Unit into the United Nations institutional memory on peacekeeping operations and to make this institutional memory easily available to officers, at Headquarters and in the field,

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[88] Twohey, Major. J. Mark, Canadian Army Lessons Learned Centre point of contact, (personal communication, e-mail questionnaire, January 22, 2002)

[89] Reiff, D, The United Nations Peacekeeping Best Practices Unit point of contact, (personal communication, e-mail questionnaire, February 1, 2002) and Lowe, S., The United Nations Peacekeeping Best Practices Unit point of contact, (personal communication, telephone, May 17, 2002)

[90] United Nations Lessons Learned System Web Page

involved in all aspects of peacekeeping missions, including their planning, managing and support.[91]

The products of the Lessons Learned Unit are reports. They fall into two categories, thematic and mission specific. Thematic reports are more general. An example is Report of the United Nations Seminar on Public Information Policies and Practices for Field Missions (1997). Another example is Disarmament, Demobilization and Reintegration of Ex-combatants in a Peacekeeping Environment: Principles and Guidelines (Dec 1999). An example of a mission specific report is Lessons Learned from the Angola Verification Missions (UNAVEM I, II and III): Interim Report (Nov 1997). This report is not published but exists as an internal report.

The Lessons Learned Unit considers there to be two sources for reports. The primary source is first hand accounts by the Lessons Learned Unit. Included in the primary sources are interviews with participants of a subject being considered for lessons learned.

> Lessons were obtained from primary sources, such as interviews with mission and Secretariat personnel, representatives of specialized agencies as well as political actors. Lessons Learned teams visited mission areas to gather first hand information for mid and end of mission assessments.[92]

The secondary sources are second hand accounts such as published papers.

> The secondary sources of information include published material, media analysis and reportage, evaluation reports of peacekeeping operations by independent experts and governments and end-of-tour reports by key personnel, both in the field and at Headquarters.[93]

The Brahimi report was released in August of 2000 after a thorough review of UN peace and security activities. Among the recommendations contained in that report was that the Lessons Learned Unit should be located where it could work more closely with and contribute effectively with ongoing operations, as well as mission planning and doctrine/guidelines development. At that time the Lessons Learned Unit merged with the

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91 United Nations Lessons Learned System Web Page

92 Ibid.

93 Ibid.

Policy and Analysis Unit to form what is now called the Peacekeeping Best Practices Unit.

As part of implementing the Brahimi report, the methodology used for extracting and validating lessons learned/best practices is currently under review. It is expected that the extracting and validating of lessons learned in the future will be similar to the past system. The past method of extracting lessons was described above, that being primary and secondary sources.

The method of validation was as follows. A first draft of a report was written by the Lessons Learned Unit. The authors then resided over an internal UN review of the draft called an expert workshop. The membership of the expert workshop consisted of departments of the UN and different levels of position. For example the Peace Keeping department and the Humanitarian department, among others, are represented and the representation consists of policy-making positions as well as lower management. The expert workshop reaches common agreement with the lessons learned and possible policy change or agrees to disagree. The authors of the report have final say on the contents of the first draft.

However one purpose of the Lessons Learned Unit has been satisfied. That is providing information on lessons learned to policy makers who can implement the lessons learned. This is done by the policy makers participating in the validation process through the expert workshop.

From the expert workshop the draft report goes through an external review. This includes member states. Member states comment on the report but again the authors have the final say. There is no requirement for the member states to sign up to the report and as such the report is not an official UN paper.

3. American Industrial Hygiene Association (AIHA) Laboratory Health & Safety Committee[94]

The American Industrial Hygiene Association Laboratory Health & Safety Committee is located in Fairfax, Virginia. Its mission statement is:

> To provide a forum on the practice of industrial hygiene and safety in the laboratory and associated research and support service settings and to participate in the development and analysis of related technological and regulatory issues.[95]

To support this mission statement, a lessons learned system has been established. The goal of the lessons learned portion of the Health & Safety Committee is to collect lessons learned as a result of laboratory mishaps. A primary source of these lessons learned are University laboratories. Also included in the lessons learned system goal is making the mishaps available to others so that mishaps are not repeated.

Lessons are obtained by advertisement for input on their web page. There is an electronic form that is made available for anyone to submit information about an incident. It is requested that the submission include not only an account of the mishap but realized "key safety concepts and principles" and include a corrective action. Other sources of lessons obtained from laboratory mishaps are those presented informally through contact with the committee members. Also there is a regular communication that exists with college laboratories that provide lessons from mishaps as well as communication with industrial laboratories.

The way lessons are considered acceptable for publishing is the submission is reviewed by a group of two or three committee members and if there appears to be a lesson to be learned from the mishap then the submission is published on their web site. Identifying information on people and facilities is not included in the publication. Also, no corrective action or interpretation is offered, just the story. Publication includes "key safety concepts and principles" and suggested corrective action.

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[94] Krethman, K., American Industrial Hygiene Association Laboratory Health & Safety Committee point of contact (personal communication, e-mail questionnaire, January 21, 2002)

[95] American Industrial Hygiene Association Laboratory Health & Safety Committee Web Page

The committee considers the lessons learned system to be successful. The mishaps are published. This meets the basic goal of collecting and publishing laboratory mishaps. It is a good collection of mishaps and they are well presented.

There is not one person responsible for the accuracy of the lessons learned system. There is a disclaimer associated with the published incidents. The disclaimer states that the safety committee does not take any responsibility for the accuracy of the incidents nor does any view necessarily reflect the views of the committee.[96]

The AIHA Laboratory Health & Safety Committee is in the developing stage. Its workforce consists of volunteer committee members and its financial needs for operation are not great. Participation after initial startup, in terms of submission of lessons, has leveled off or been slow. Most submissions of lessons have been from those sought out.[97]

4. U.S. Army Center for Engineer Lessons Learned[98]

The purpose of the U.S. Army Center for Engineer Lessons Learned is to collect, analyze and incorporate Engineer lessons learned. Some examples of the subject of these lessons learned are the performance of vehicles and the operation of mine clearing devices.[99] The U.S. Army Center for Engineer Lessons Learned is separate from the Center for Army Lessons Learned but collaborates with the latter whenever possible.[100]

Lessons are obtained in a few ways. In a large-scale operation, the Center for Army Lessons Learned will send out a Combined Arms Assessment Team to observe and

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[96] American Industrial Hygiene Association Laboratory Health & Safety Committee Web Page

[97] Krethman, K., American Industrial Hygiene Association Laboratory Health & Safety Committee point of contact (personal communication, e-mail, July 9, 2002)

[98] Snodgrass, R., U. S. Army Center for Engineer Lessons Learned point of contact, (personal communication, e-mail questionnaire, January 24, 2002)

[99] Snodgrass, R., U. S. Army Center for Engineer Lessons Learned point of contact, (personal communication, telephone, July 16, 2002)

[100] Snodgrass, R., U. S. Army Center for Engineer Lessons Learned point of contact, (personal communication, telephone, July 10, 2002)

interview so as to collect lessons learned. There are instances when a member of the team is part of Army Center for Engineer Lessons Learned. Appropriate lessons are then brought to the Army Center for Engineer Lessons Leaned. Another way is similar except the Combined Arms Assessment Team performs observation and interviews at the Combined Arms Training Center.

In smaller operations, on-going operations, and other training missions, the units involved will provide lessons learned directly to the Army Center for Engineer Lessons Learned. The vehicle often used is an After Action Report from the participating units.

The method of validating the lessons learned is done at the time of collection. The Combined Arms Assessment Team confirms the observation with the unit for accuracy. When the unit submits an After Action Report, the After Action Report is considered accurate, as the After Action Report is what is used to brief their higher headquarters. The After Action Report is also validated by comparing it with previous information in the specific area. If there is some discrepancy the After Action Report will be rechecked with the submitting unit.

The validation continues with subject matter experts reviewing the lessons learned. If it is necessary they will perform tests to ensure the information is correct. From there the lessons learned are distributed to the appropriate place.

The Army Center for Engineer Lessons Learned considers itself successful. Lessons learned input has effected changes to doctrine, training and equipment. There are serious consequences for disseminating erroneous or misleading lessons learned. The consequences could be mission failure, injury or equipment failure.

The Army Center for Engineer Lessons Learned is in the development stage and receiving lessons learned is its present concern. Although the method of lessons gathering involves some active sourcing, the system is mostly passive in this regard and there is a concern that there are lessons learned that exist in the field that are not reaching The Army Center for Engineer Lessons Learned system.[101]

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[101] Snodgrass, R., U. S. Army Center for Engineer Lessons Learned point of contact, (personal communication, telephone, July 10, 2002)

5. Army Medical Department Lessons Learned[102]

The purpose of the Army Medical Department Lessons Learned is to collect, analyze and disseminate US medical unit experiences and lessons learned. It existed in some form in 1991 but its present form has its beginnings in 1998 so it is relatively new. The Army Medical Department Lessons Learned is separate from the Center for Army Lessons Learned although there is collaboration whenever possible.[103]

Lessons are obtained by unit or individual submissions. By definition, the submissions contain observations or issues; they are not considered lessons learned at this point in the process. The unit observations or issues are analyzed by the Army Medical Department Lessons Learned office and forwarded to the appropriate subject matter proponent for validation and verification. Based on the subject matter expert analysis and proponent verification, the Army Medical Department Center staff directs work on a solution by the Army Medical Department Center and School. The proponent then validates the solution.

This is a formal process and the reason this process is formal is to ensure that recommendations are appropriate for the observation. Everything that is submitted is reviewed but not everything is forwarded to the proponent office for action.

In some cases, a Combat Training Center focused rotation is used to test and validate a new concept or a solution to one of the observations developed by the Army Medical Department Center and School. In other cases, a unit may volunteer to test the new concept or solution. There is an Army Medical Department Lessons Learned Board that monitors if the solution works. If the solution does not work, then the proponent staff begins again. If a solution is obtained, then the solution is validated and the solution becomes a Lesson Learned. A Lesson Learned is defined as an Army Medical Department-wide change as a result of a submitted observation.

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[102] Rathbun, G., Army Medical Department Lessons Learned point of contact, (personal communication, e-mail questionnaire, January 27, 2002)

[103] Rathbun, G., Army Medical Department Lessons Learned point of contact, (personal communication, telephone, July 10, 2002)

The Army Medical Department Lessons Learned has been successful. Here is an example. A Combat Training Center observation was Medical unit leaders are not proficient in battle tracking.[104] This was validated as an observation over three Combat Training Centers and several rotations. The solution was to add a battle tracking course to the Officer Basic Course. The National Tracking Center has verified that battle tracking has improved.

Lessons Learned effect the entire Army Medical Department. They become Army Medical Department Doctrine, Mission Training Plans and Programs of Instruction and other products for which the Army Medical Department Lessons Learned Center and School are proponents. Because of this, there are few Lessons Learned compared to observations.

The present concern is obtaining lessons learned. Although active observations occur there is a reliance on input from field activities. These field activities do not hold supporting the Army Medical Department Lessons Learned Center as a high priority and there is no penalty for the omission. There is also missed opportunity. For example, there is no Center for Army Lessons Learned representatives in Afghanistan.[105]

It was noted that the Navy is starting a program similar to the Army Medical Department Lessons Learned Center with preliminary acronym of NOMI. This will allow collaboration, which is most appropriate.

6. Coast Guard - Standard After Action Information and Lessons Learned System[106]

The purpose of the Coast Guard - Standard After Action Information and Lessons Learned System is to capture After Action Reports, Lessons Learned and Best Practices. It is to share this information amongst Coast Guard Commands and to other Federal

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[104] Combat Training Center observation

[105] Rathbun, G., Army Medical Department Lessons Learned point of contact, (personal communication, telephone, July 10, 2002)

[106] Burt, M., Coast Guard – Standard After Action Information and Lessons Learned System point of contact, (personal communication, e-mail questionnaire, January 24, 2002)

Agencies as necessary. It is to have this information to enhance unit preparedness, readiness and training. It was established in October 2001.

The Coast Guard - Standard After Action Information and Lessons Learned System is accessible on the Coast Guard Intranet. Lessons for the Coast Guard - Standard After Action Information and Lessons Learned System are obtained by Coast Guard Units linking to the site and entering a lesson learned. Lessons Learned are also released to the Coast Guard - Standard After Action Information and Lessons Learned System by Coast Guard Headquarters. Coast Guard Units link to the site to review posted lessons learned.

To provide validation to the lessons learned submitted to the Coast Guard - Standard After Action Information and Lessons Learned System, structural guidance is provided to the units that reports entered into the Coast Guard Standard After Action Information and Lessons Learned System are considered Command approved. There is also a non-mandatory request to include the name of the person or unit entering the lesson learned. This provides some check that lessons learned submitted are authorized and Command approved. The Coast Guard - Standard After Action Information and Lessons Learned System Administrator reviews the submitted lessons learned before posting on the Coast Guard - Standard After Action Information and Lessons Learned System Intranet website. Some lessons learned submitted pertaining to certain subjects are required to be forwarded to Coast Guard Headquarters for review.

The Coast Guard Headquarters reviews these lessons learned. It also reviews reports generated by Coast Guard Units that have been reviewed and approved through the Chain of Command leading to Coast Guard Headquarters. Abstracted from review of the lessons learned and reports is information that is used to prepare releases to the Coast Guard - Standard After Action Information and Lessons Learned System to be published on the Intranet website.

The main users of the Coast Guard - Standard After Action Information and Lessons Learned System are Coast Guard Unit contingency planners. An erroneous or misleading report could effect the efficiency of the Coast Guard to perform its mission. The Command Approval and reviews minimizes the possibility that erroneous or

misleading reports are placed into the Coast Guard - Standard After Action Information and Lessons Learned System Intranet website. There is also the ability to pull back off the website a lesson learned that is erroneous or misleading.

The Coast Guard - Standard After Action Information and Lessons Learned System has been successful. This is based on the number of lessons learned received. This is also based on the usage of the Coast Guard Standard After Action Information and Lessons Learned System Intranet website. This initial success is guarded however and the present concern is for there to be a continued contribution of lessons learned from the field, as this is not a requirement.[107]

7. Best Manufacturing Practices Program[108]

The Best Manufacturing Practices Program is sponsored by the Office of Naval Research. It was created in 1985 to overcome the wide and very costly variances in the quality of goods and services being received by the Navy from contractors throughout the United States.[109] Navy contractors voluntarily agree to share their solutions to manufacturing process problems still being experienced by other Navy contractors. The Best Manufacturing Practices Program provides the data gathering, validation and dissemination. The goal of the Best Manufacturing Practices Program is to improve the quality, cost, and reliability of goods and services the Navy receives.

Manufacturing processes as defined above includes technical and administrative. For example a best practice may be to use integrated teams consisting of multiple disciplines in designing a product. A company may decide to implement this best practice. In implementing this best practice, the lessons learned are recorded. Included in the writings of the Best Practices database of the website are listed the lessons learned.[110]

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[107] Burt, M., Coast Guard – Standard After Action Information and Lessons Learned System point of contact, (personal communication, telephone, July 10, 2002)

[108] Robertson, L., Best Manufacturing Practices point of contact, (personal communication, e-mail questionnaire, February 7, 2002)

[109] Halbig, L., Description of Best Manufacturing Practices Program, provided January 24, 2002

[110] Best Manufacturing Web Page

The acceptance of best practices is done very formally by the use of survey teams. A participating company notifies the Best Manufacturing Practices Program of a best practice that the company is willing to share. A pre-survey team visits the company to obtain preliminary information and plan for a future visit by a formal survey team appropriate to the subject matter if they consider the best practice worth pursuing. The formal survey team comprised of impartial experts from government, industry, and academia visits the company and documents what they feel qualifies for a best practice. The best practice is then disseminated through the Best Manufacturing Practices Program Internet website. It is reviewed for technical accuracy by the surveyed company before it is released. Often times the release includes information about a new product or process of the company.

The purpose of the Lessons Learned portion, included in the writings located in the Best Practices database in the Best Manufacturing Practices Program Internet website is to make others aware of some of the pitfalls that the company implementing the Best Practice encountered so that another company or activity implementing the same or similar practice does not repeat the same mistake.[111]

Lessons are obtained by inclusion within write-ups by companies who are participating in a Best Manufacturing Practices Program review of the Best Practice. The validation of the Best Practice, as described above, is very formal but there is no validation of the lessons learned.

No measure of success for the Lessons Learned portion has been attempted. The Best Manufacturing Practices Program has been successful, being the winner of the Innovations in American Government Award and the Vice President's Hammer Award.

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[111] Robertson, L., Best Manufacturing Practices point of contact, (personal communication, e-mail questionnaire, February 7, 2002)

8. Department of Energy Project Hanford Lessons Learned System[112]

The Project Hanford Lessons Learned System serves the Hanford Site located along the Columbia River in southeastern Washington State. Hanford produced plutonium for the Manhattan Project during World War II and the Cold War and is now undergoing environmental restoration under the Department of Energy.[113]

The Department of Energy Project Hanford Lessons Learned System assumed its present form in 1994 and is a mature system.

The purpose of the Project Hanford Lessons Learned System is to publicize good work practices so others can adopt them to improve efficiency and performance and to share lessons learned arising from accidents so that others can avoid making the same or similar errors.[114]

A lesson learned for the Project Hanford Lessons Learned System is defined consistent with DOE Standard 7501-99 December 99. Lessons are obtained for the Project Hanford Lessons Learned System in the following way. Each day, the Lessons Learned Coordinator screens the Department of Energy Occurrence Reporting and Processing System for events across the Department of Energy Complex that could also happen at the Hanford site. These events become input into a process that could lead to a lessons learned at the Hanford site. Also included as input when deemed appropriate are Hanford site items from the corrective action management group.

A list server also provides lessons learned from other Department of Energy Lessons Learned Systems. These lessons learned are then passed to the appropriate Hanford Site management for action as appropriate.

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[112] Bickford, J., Department of Energy Project Hanford Lessons Learned System point on contact, (personal communication, e-mail questionnaire, January 24, 2002)

[113] Bickford, J., Department of Energy Project Hanford Lessons Learned System point on contact, (personal communication, e-mail, questionnaire, July 9, 2002), see also http://www.hanford.gov/rl/siteinfo/knowus.asp

[114] Bickford, J., Department of Energy Project Hanford Lessons Learned System point on contact, (personal communication, e-mail questionnaire, January 24, 2002)

A draft lesson learned is prepared from the inputs mentioned previously by the Lessons Learned Coordinator. The draft lesson learned is then e-mailed to subject matter experts, Lessons Learned Point-of-Contact at the originating facility if applicable, the originator if the event is from the Hanford Site and management as appropriate. A set time is given to provide comments otherwise it is considered concurred with. The comments are incorporated and possibly sent out as a draft again. When there is concurrence, the draft becomes a lesson learned and is entered into the Project Hanford Lessons Learned System.

The Project Hanford Lessons Learned System has been a success.

> Several prevented or mitigated accidents can be traced directly to the Project Hanford Lessons Learned System.[115]

The overall accident/injury rate has also decreased over the last seven years and this is partly due to the Project Hanford Lessons Learned System. Also many of the Project Hanford Lessons Learned System good work practices have been implemented leading to more efficient operation at the Hanford site.

It was noted that, in general, the consequences of disseminating erroneous or misleading lessons learned, aside from the consequences related to implementation of the misleading lesson learned, is an erosion in the credibility of any Lessons Learned System and the associated reduction in its value. For this reason, the Lessons Learned Coordinator, with reliance on subject matter experts, assumes full responsibility for the accuracy of the Project Hanford Lessons Learned System, which is an exemplary example of a quality Lessons Learned System.

A few years ago, General Motors invited the Hanford Lessons Learned Coordinator to provide guidance for their quality improvement initiative. One suggestion was to keep the Lessons Learned System simple and familiar.

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[115] Bickford, J., Department of Energy Project Hanford Lessons Learned System point on contact, (personal communication, e-mail questionnaire, January 24, 2002)

> Make the system fit within the tools your workers use every day so they do not need to learn something new. If they use Lotus Notes, build your system in that suite. If your business uses an intranet extensively, use that. If e-mail is the communication medium of choice, send lessons learned by e-mail.[116]

Other suggestions included the need for management support at all levels and tailoring the distribution to the user. The Hanford Lessons Learned System is a mature Lessons Learned System and its success can probably be attributed to its methods and personnel.

9. BNFL Incorporated Lessons Learned System[117]

BNFL Incorporated is a wholly owned subsidiary of British Nuclear Fuels Limited. BNFL Incorporated provides decontamination and decommissioning resources. BNFL Incorporated holds a contract with the Department of Energy to remove equipment and decontaminate three huge former process buildings at the Department of Energy Oak Ridge Tennessee Technology Park.[118]

The purpose of the BNFL Incorporated Lessons Learned System is to identify good practices within BNFL and the Department of Energy and to provide these practices to the current project at Oak Ridge for implementation. It is also to identify poor work practices within BNFL so they will not be repeated and poor work practices within the Department of Energy so they can be avoided.

Lessons are obtained through the Department of Energy List Server, through internal BNFL events and through on site events. On site events and BNFL corporate events are analyzed for causes and lessons are developed based on a causal analysis.

To the BNFL Incorporated Lessons Learned System, verification is the act of ensuring that a lesson was developed for an event and distributed. Validation is the act of

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116 Bickford, J., Department of Energy Project Hanford Lessons Learned System point on contact, (personal communication, e-mail, questionnaire, July 9, 2002}

117 Cooter, M., BNFL Inc. Lessons Learned System point of contact, (personal communication, e-mail questionnaire, January 29, 2002)

118 BNFL Web Page

ensuring that the lesson effectively addressed the event and the corrective action prevented recurrence of the event. The degree of formality used in validation and verification depends on the significance of the event. If the significance has potentially serious consequences such as loss of life, injury to multiple workers or adverse environmental consequences, then the degree of formality is high. When the event is positive, such that it would generate a good work practice, the events are rarely validated.

The validation process consists of a reviewer or a set of reviewers monitoring for the precursors of the event that initiated the lesson learned. This is done over a period of time. If the event or its precursors[119] do not occur then it is concluded that the lesson learned included an accurate corrective action. If the event is repeated, for example if there is a repeat of inadvertent disconnection of electrical lines, or repeats of similar nature such as repeat incidents of insufficiently trained personnel making work control errors, then there is a new analysis, a new lesson and a new set of actions.

The success of the BNFL Incorporated Lessons Learned System has been mixed. There are a vast number of events that are transformed into a lesson learned. Issuing the lessons through the BNFL Incorporated Lessons Learned System is easy; ensuring their appropriate incorporation in work plans is more difficult. If the initiating event is serious, then incorporation is most likely. The easiest lessons to enforce are those relating to product failures or recalls. Lessons based on events that led to curtailing of activities are also usually implemented. Positive practices leading to increased efficiency are given the least attention by implementers.

The consequences of disseminating an erroneous or misleading lesson learned is dependent of the seriousness of the originating event. It was also pointed out that there would be a lessened reliance on the BNFL Incorporated Lessons Learned System if it were sometimes inaccurate with lessons. In order to expedite lessons but not reduce quality, which may be time consuming, some lessons are released as an alert with the statement “this alert is based on immediately available information and will be updated as

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[119] Cooter, M., BNFL Inc. Lessons Learned System point of contact, (personal communication, e-mail, July 17, 2002)

further investigation is completed."[120] The BNFL Incorporated Lessons Learned System puts a very high priority on accuracy versus quantity.

10. Department of Energy Headquarters Lessons Learned System[121]

The United States Department of Energy has over one hundred different laboratories and contractors involved in thousands of activities. The Department of Energy Headquarters Lessons Learned System provides a central location for efficient searches of valuable Lessons Learned information. This information can be divided into two categories. One category is information on events that occurred at Department of Energy sites and the analysis of which can lead to operational benefits at the site. The second category is to provide guidance and information on Lessons Learned Systems themselves.

The Purpose of the Department of Energy Headquarters Lessons Learned System is to facilitate continuous and systematic information sharing and learning across the Department of Energy Complex. This is to promote safety, cost effectiveness, greater efficiency, better operational results and fewer mistakes. Costs are reduced by providing information on success stories that if implemented would lead to increased efficiency at a Department of Energy site. Costs are also reduced by providing information on costly mistakes that could be avoided. The purpose is also to connect other sites with experts doing similar work for their experiences. The Department of Energy Headquarters Lessons Learned System also provides Lessons Learned resources such as information on publications, conferences and workshops relating to Lessons Learned Systems.

Lessons are obtained in multiple ways. One way is by conducting critiques after an accident. Another is through procedures for performing work activities. A requirement of the procedure is documenting what went well, what did not go well and feeding the information back to the work planner to adjust the work packages. This is

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[120] Cooter, M., BNFL Inc. Lessons Learned System point of contact, (personal communication, e-mail questionnaire, January 29, 2002)

[121] Breslau, B. A., Department of Energy Headquarters Lessons Learned System point of contact, (personal communication, e-mail questionnaire, January 24, 2002)

more applicable to local activities but Lessons Learned are entered into the Department of Energy Headquarters Lessons Learned System. Also as part of any activity, on completion of a project, for a process and program review, lessons are obtained.

Each Department of Energy component has its Lessons Learned System that is run by a Lessons Learned Coordinator. The Coordinator facilitates the capture and dissemination of information. The Coordinator relies on subject matter experts to assist in preparing a lesson learned such that it will be technically accurate. Anyone may submit a lessons learned or good work practice. The submittal goes through the Lessons Learned Coordinator who will pass it to various departments such as maintenance, research and development, or training as appropriate. In some cases the lesson is reviewed by the subject matter experts to insure technical accuracy before dissemination.

The Department of Energy Headquarters Lessons Learned System has been successful. There are many examples where information provided to an organization improved efficiency or prevented a recurrence of an accident. The system is not perfect however. There are cases where lessons learned information was received by an organization but not acted on resulting in the recipient suffering the same consequences as the group providing the lesson learned.

11. Department of Energy Office of Environmental Management Lessons Learned Program[122]

The Department of Energy Office of Environmental Management Lessons Learned Program promotes the sharing of knowledge across the Department of Energy – Environmental Management complex with an emphasis on lessons learned relevant to environmental management business and functional areas. It was established in 1996 and is a somewhat mature although still developing Lessons Learned System.

The tools used in the collection and dissemination of lessons learned include the Department of Energy Office of Environmental Management Lessons Learned Program website, the on-line Lessons Learned database and the Department of Energy Listserver.

122 McCune, M., Department of Energy Office of Environmental Management Lessons Learned Program point of contact, (personal communication, e-mail questionnaire, February 2, 2002)

Lessons are obtained in a number of ways. One way is through the Department of Energy's formal occurrence reporting system. Another is through the submittal of lessons learned on the Department of Energy Office of Environmental Management Lessons Learned Program web page. This is how most Department of Energy sites send their lessons. Lessons are also obtained through subscription to other offices or agencies' listservers and actively seeking lessons at meetings and workshops such as the Technical Information Exchange Workshop.

The degree of formality in the Department of Energy Office of Environmental Management Lessons Learned Program depends on the field office from where it originates. Each field office has its own management system for validation of the lesson. They are also reviewed at the field level public relations department to insure the lesson learned does not contain any classified information. When the lessons learned are received at the Department of Energy Office of Environmental Management Lessons Learned Program they are given a cursory check to make sure the lesson reads well and that all the necessary fields of the lesson learned form are filled in. If the lesson is received through the Department of Energy Office of Environmental Management Occurrence Reporting System, that system has formal review components in place so the lesson does not get reviewed again.

The collection of review systems, field office and occurrence reporting system, protect against the release of classified information and technical accuracy in accounting the lesson or success story.

The Department of Energy Office of Environmental Management Lessons Learned Program has been successful. The Department of Energy Office of Environmental Management Lessons Learned Program has evidence of cost savings/cost averted based on sharing of success stories and lessons learned.

The present concern is for lessons learned in the field to reach The Department of Energy Office of Environmental Management Lessons Learned Program. A secondary concern is for the lessons learned to reach the people who can use them.[123]

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[123] McCune, M., Department of Energy Office of Environmental Management Lessons Learned Program point of contact, (personal communication, e-mail, July 10, 2002)

Based on experience and success, some suggestions to future designers are provided:[124]

1. Make sure the database application is supported and upgradeable to grow with the Lessons Learned System.

2. A good search engine is important.

3. Simplicity and ease of use are the keys to a Lessons Learned System that people will use.

4. Design the system for the ability to create reports that trend the lessons in the database with ease.

5. Design the Lessons Learned System so that it is not only pushing information out but also pulling information in (push pull).

6. Provide a number of different formats that a lessons learned provider can use to prepare a lessons learned.

12. Federal Transit Administration Lessons Learned System[125]

The Federal Transit Administration deals with public transportation. Public transportation may include buses, rail vehicles and system, commuter ferryboats, trolleys, subways, etc. The U.S. Department of Transportation, through the Federal Transit Administration, provides financial and technical assistance to the local transit systems.[126]

The purpose of the Federal Transit Administration Lessons Learned System is to share knowledge on the successes, the challenges (mishaps) and applications of new technology in the building of the United States' public transportation system. It was established in January of 1995 and is a developing Lessons Learned System.[127]

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[124] McCune, M., Department of Energy Office of Environmental Management Lessons Learned Program point of contact, (personal communication, e-mail, July 10, 2002)

[125] Nassif, S, Federal Transit Administration Lessons Learned System point of contact, (personal communication, telephone questionnaire, January 25, 2002)

[126] Federal Transit Administration Web Page

[127] Nassif, S, Federal Transit Administration Lessons Learned System point of contact, (personal communication, telephone, July 10, 2002)

The usual method of doing business is to supply grants to municipalities for their public transportation system. These grants may be used to build transit, for project construction, for hardware such as busses and to develop transit systems. The municipalities or grant recipients normally hire a consultant to administer the project financed by the grant. While construction is taking place or as the grant is being used, the consultant collects lessons learned as part of the contract.

Once a year, there is a round table discussion that includes the Federal Transit Administration Lessons Learned System, the grant recipients and their consultants. Part of the agenda is to discuss lessons learned. The lessons learned may involve financial, safety, design and all other aspects of the project sponsored by the grant. A report is written including the lessons learned. The report with lessons learned is used by the Federal Transit Administration in the planning and administering of future grants. The report with lessons learned is retained with the National Transit Library.

The Federal Transit Administration Lessons Learned System has no present concerns although it is constantly seeking to improve. Lessons learned are part of each grant, they are reviewed by policy making personnel at the round table discussion and the lessons learned are used in future operations. The Federal Transit Administration Lessons Learned System has high management including financial support.[128]

13. International Space Station Lessons Learned Database[129]

The International Space Station is a project to build an orbiting laboratory in space that will house scientists and astronauts. The International Space Station will have a mass of 1,040,000 pounds and will measure 356 feet across and 290 feet long. It will have almost an acre of solar collectors and six state of the art laboratories. It will orbit at 250 miles. The project is lead by the United States in partnership with Canada, Japan,

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[128] Nassif, S, Federal Transit Administration Lessons Learned System point of contact, (personal communication, telephone, July 10, 2002)

[129] Vassberg, N., International Space Station Lessons Learned Database point of contact, (personal communication, e-mail questionnaire, February 8, 2002)

Russia, 11 nations of the European Space Agency and Brazil. Assembly is planned to be complete in 2004.[130]

The purpose of the International Space Station Lessons Learned Database is to archive lessons learned from the International Space Station for future NASA programs in an easy to use/access/categorized form. Another purpose is to document lessons learned and measures taken to prevent recurrence at multiple sites. This is key for a program the size of the International Space Station with multiple facilities in the United States and around the world. It is possible to learn the same lesson multiple times without the communication tool to transfer the learned knowledge. The International Space Station Lessons Learned Database is the tool used to implement lessons learned and prevent recurrence.

It has existed in its present form since 1998. It began four years earlier as a collection of lessons obtained from the space shuttle docking with the Russian Mir Space Station. Those lessons were originally in a spreadsheet. A desire to disseminate the lessons for the International Space Station was the driving force behind the development of The International Space Station Lessons Learned Database.[131]

Lessons are obtained by the organization that learns the lesson submitting the lesson on a voluntary basis. There is no formal requirement to submit a lesson that is learned to the International Space Station Lessons Learned Database. The present concern, being a passive collection system, is the obtaining of lessons. Some methods to increase the submittals of lessons have been tried. One method was a reward system. A free dinner was given to those having lessons accepted for dissemination. It stimulated lesson submission until the novelty wore off.[132]

Once a lesson is received by the International Space Station Lessons Learned Database, it is processed in the following way. First it is categorized as belonging to one of twelve possible technical discipline areas. For each of the twelve disciplines there is a

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[130] International Space Station Web Page

[131] Vassberg, N., International Space Station Lessons Learned Database point of contact, (personal communication, telephone, July 11, 2002)

[132] Ibid.

reviewer who when assigned the lesson learned, determines first if the lesson is a lesson. The reviewer also judges if the right level of detail is included so that a reader can understand the lesson. The reviewer determines if the categorization is correct and makes sure that there is no sensitive or personal data included.

Once this initial screening is completed by the International Space Station Lessons Learned Database, the lesson is forwarded to a management board for the technical discipline to review. The management board concurs with the initial screening or makes changes or rejects the lesson. The two-step process assures the management board is not overloaded with lessons and is a check on the initial review.

This degree of formality on the validation process is used to insure that the International Space Station Lessons Learned Database contains quality lessons learned. It is the feeling of the International Space Station Lessons Learned Database that if the database becomes cluttered with junk lessons, the International Space Station Lessons Learned Database loses its value. If its value is reduced, there will be a hesitancy to use the International Space Station Lessons Learned Database. There is a credibility that exists when the management board endorses a lesson and this encourages International Space Station Lessons Learned Database use.

The International Space Station Lessons Learned Database has been successful. The corrective actions that have been taken have demonstrated a reduction in the recurrence of problems.

There are several International Space Station Lessons Learned Database perceived consequences for disseminating an erroneous or misleading lesson learned. One of the consequences is that there will be a decline in usage of the International Space Station Lessons Learned Database. A second consequence is that an unnecessary or wrong action will be taken that could effect safety, efficiency, etc. The International Space Station Lessons Learned Database focuses on the root cause of the lesson. If the root cause is accurate then corrective actions should work.

The International Space Station Lessons Learned Database not only focuses on obtaining quality lessons but also on distributing them. Once a lesson is approved by the management board for a technical discipline, the system automatically distributes it to

predetermined people or groups who need to see and respond to the lessons. This assures that the users know that a new lesson is in the system that deals with their area.

The dissemination goes further. The disseminated lesson learned are tracked and if a lesson learned is observed to be idle in one work station, that work station is reminded that appropriate action needs to be taken.[133]

This would be an example of the overall process. A site in California learns a lesson and submits the lesson to the International Space Station Lessons Learned Database. The International Space Station Lessons Learned Database reviews the lessons and forwards it to the management board of Test & Verification. The Management Board of Test & Verification approves the lesson learned. The lesson learned is then sent by e-mail to the Test & Verification groups at all program sites. Key individuals are required to respond to the International Space Station Lessons Learned Database to document if/how the lesson applies to them and what they have done as a result of the lesson. The database captures these responses as part of the original lesson. This closed loop assures that the International Space Station is learning from its lessons.

The development of The International Space Station Lessons Learned Database continues. Capitalizing on their in house expertise, the software involved in dissemination of lessons learned is state of the art. Video and audio are now included in the dissemination of lessons learned bringing with them all their advantages. The resource drain of The International Space Station Lessons Learned Database is not great as tasks are spread throughout the organization thus creating no great burden for a few.

The key to The International Space Station Lessons Learned Database success, aside from design and processes, is management support at all levels, particularly upper management. The positive effects on lessons learned submission activity as a result of a few passing words regarding lessons learned importance by high profile managers to lower managers and workers is noticeable.[134]

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[133] Vassberg, N., International Space Station Lessons Learned Database point of contact, (personal communication, telephone, July 11, 2002)

[134] Ibid.

14. Mine Action Information Center Lessons Learned Database[135]

The Mine Action Information Center is an established Center of Excellence by the Department of Defense at James Madison University. Its mandate is to collect, process, analyze and disseminate information relevant to humanitarian mine action clearance, victim assistance, community risk reduction, refugee resettlement and other land mine related issues. Its partners include The Department of State, the Department of Defense, the Slovenian International Trust Fund, the Canadian government and The Geneva International Center for Humanitarian Demining.

The purpose of the Mine Action Information Center Lessons Learned Database is to capture lessons learned from humanitarian demining operations. It is designed to serve the entire mine action community by providing a method and forum for distributing experiences and methodologies that may be of benefit to others. It began operation in the spring of 2001.

Lessons are obtained from operators who enter them into the system after a deployment. The Mine Action Information Center Lessons Learned Database Internet website also allows lessons learned to be entered by anyone who will register into the system.

There is no validation of lessons. Lessons are accepted as is. The reason there is no validation process is to encourage the widest scope and amount of input. The Mine Action Information Center Lessons Learned Database Intranet website also allows comments to be made with regard to lessons posted so in a sense, the system is self-policing. The validity of the lesson learned can be judged by comments entered in reference to the lesson.

The Mine Action Information Center Lessons Learned Database does not consider itself to be fully successful yet. It cites a limited amount of input information. To improve upon this, the Mine Action Information Center Lessons Learned Database is conducting an outreach-marketing plan.

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135 Barlow, D., Mine Action Information Center Lessons Learned Database point of contact, (personal communication, e-mail questionnaire, May 22, 2002)

The consequences of disseminating an erroneous or misleading lesson learned is not of as great of concern as there being limited sharing of demining lessons learned. In other words, at this point in the Mine Action Information Center Lessons Learned Database development, the Mine Action Information Center Lessons Learned Database would prefer quantity of lessons over quality and allow a self-policing to establish the quality.

There is a disclaimer associated with the Mine Action Information Center Lessons Learned Database that states that messages are not edited for content and opinions are those of the users posting information and are not attributable to the Mine Action Information Center Lessons Learned Database or its partners.[136]

Recently, there has been a revision to operating procedure. Lessons are now also sought from open literature and entered into the database by Mine Action Information Center Lessons Learned Database personnel.[137]

15. Electric Boat Corporate Lessons Learned Database[138]

With more than a century of experience, Electric Boat has established standards of excellence in the design, construction and lifecycle support of submarines for the U.S. Navy. Primary operations are the shipyard in Groton, CT, and the automated hull-fabrication and outfitting facility in Quonset Point, RI, with a current workforce of nearly 9,000 employees.[139]

As a good business practice, Electric Boat has established the Electric Boat Corporate Lessons Learned Database. Lesson Learned Systems have existed at Electric Boat for some time. These systems were local in nature. Each design project included a lessons learned system and lessons learned systems were also a part of functional groups

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[136] Mine Action Information Center Lessons Learned Database Web Page

[137] Barlow, D., Mine Action Information Center Lessons Learned Database point of contact, (personal communication, e-mail, July 11, 2002)

[138] Thaxton, D., Electric Boat Corporate Lessons Learned Database point of contact, (personal communication, questionnaire, June 22, 2002)

[139] General Dynamics Electric Boat Web Page

such as testing or nuclear engineering. These systems were independently operated. Some were paper and some were electronic. The Electric Boat Corporate Lessons Learned Database was established to umbrella all of the local lessons learned systems. It is an Intranet website.

The purpose of the Electric Boat Corporate Lessons Learned Database is to provide global lessons learned during design, manufacture, test and operation of Navy ships and land based prototypes to the Electric Boat community. This database does not supercede existing department or project lesson learned files, but provides an area where critical lessons, both successes and failures, are easily accessible by the larger community.

Lessons are obtained from the local lessons learned systems. The management of the local lessons learned systems judges that a lesson learned existing in the local system has value beyond the local level. The lesson learned has value to the larger Electric Boat community. The local management then enters the lesson learned into an electronic submittal form of the Electric Boat Corporate Lessons Learned Database intranet website. Lessons learned are also obtained by scanning a lessons learned database of a wide area network serving a select group of organizations. Another source of lessons is by the implementation of shipyard procedures governing work reviews.

Lessons learned of the Electric Boat Corporate Lessons Learned Database are validated by two levels of review. The first level is by the submitting source. The lessons are judged to be accurate and global by local lessons learned managers, wide area network publishers or management presiding over work reviews. The second validation is by an Electric Boat Corporate Lessons Learned Database review board consisting of five managers representing major disciplines at Electric Boat. These disciplines are engineering, operations, test, quality control and radiation control. The criteria for validation includes that lessons have properly undergone Navy root cause analysis, are globally applicable and are written to a standard appropriate for dissemination.

The Electric Boat Corporate Lessons Learned Database has been somewhat successful. There is evidence that the database is being accessed by the Electric Boat

community for lessons learned. There may be a need to increase the population of lessons learned in the Electric Boat Corporate Lessons Learned Database.

There is an Electric Boat requirement that new design projects review the lessons learned from past design projects. The development of database technology with increased speed in searching for specific subjects with user friendliness has made a global lessons learned system feasible at Electric Boat.

C. ORGANIZATION OF EXISTING LESSONS LEARNED DATA

The data is organized to support the methodology of analysis. The phrase existing Lessons Learned System represents the sample of Lessons Learned System in Section B and is not meant to represent all existing Lessons Learned Systems.

A key code is established for each Lessons Learned System as indicated in Table IV-1 below:

Table IV-1 Key Code of Existing Lessons Learned Systems	
Key Code	**Lessons Learned System**
1	Canadian Army Lessons Learned Centre
2	The United Nations Peacekeeping Best Practices Unit (formerly The Lessons Learned Unit of the Department of Peacekeeping Operations)
3	American Industrial Hygiene Association (AIHA) Health & Safety Committee
4	U.S. Army Center for Engineer Lessons Learned
5	Army Medical Department Lessons Learned
6	Coast Guard - Standard After Action Information and Lessons Learned System
7	Best Manufacturing Practices Program
8	Department of Energy Project Hanford Lessons Learned System
9	BNFL Incorporated Lessons Learned System
10	Department of Energy Headquarters Lessons Learned System
11	Department of Energy Office of Environmental Management Lessons Learned Program
12	Federal Transit Administration Lessons Learned System
13	International Space Station Lessons Learned Database
14	Mine Action Information Center Lessons Learned Database
15	Electric Boat Corporate Lessons Learned Database

Table IV-2 below lists the data from which a Handling Variable Set can be determined.

Table IV-2 Handling Methods of Existing Lessons Learned Systems	
Key Code	**Handling Methods**
1	written by source on standard form, reviewed by supervisor, analyzed and root cause determined centrally, suggestions forwarded, feedback to initiator
2	reports generated at site, edited by group of experts including users and policy makers centrally, final report for dissemination
3	lessons received, reviewed by group, edited to make generic, published
4	observations forwarded (mild requirement), reviewed by experts centrally, perform tests to verify
5	observations forwarded (mild requirement), reviewed by experts and solutions developed centrally, feedback on solutions
6	written by source and forwarded (mild requirement), command review, reviewed centrally, edited as needed, published
7	included in write-up as format of implementation review, no review
8	actively search for lessons, filter and reviewed by experts centrally
9	actively search for lessons, developed centrally, validated by checking results and monitoring for the reoccurrence of event
10	actively develop by critiques and work procedures requirement, subject matter experts to develop
11	voluntary submission, actively search (secondary), reviewed centrally for editorial and public relations
12	requirement of contract to include, general review by policy makers, publish as report
13	received from volunteers, categorize and review, higher review and acceptance, selectively disseminated with an action to respond requirement
14	written by source/voluntarily submitted, no processing, allow comments to be posted against
15	submitted voluntary from local, reviewed by local, reviewed centrally, published

Table IV-3 below identifies the organizational aspects of the Lessons Learned System that are applicable to the methodology. These are not the organizational characteristics that are referred to in Chapter II. Included is the goal or purpose of the organization, the development stage of the Lessons Learned System and the present concern. The present concern is either population of lessons, quality of lessons, use of lessons by the organization.

Table IV-3 Organizational Aspects of Existing Lessons Learned Systems

Key Code	Goal or Purpose	Development Stage	Present Concern
1	improve operational capability and efficiency	mature	implementing lessons
2	recommend actions for future operations	developing	implementing lessons
3	knowledge sharing (collect and supply mishap information)	developing/ mature	receiving lessons
4	improve engineering performance	developing	receiving lessons
5	improve methods of operation, medical	new/ developing	receiving lessons
6	enhance unit preparedness	new/ developing	receiving lessons
7	provide awareness concerning implementation		
8	improve efficiency, operations and prevent accidents (safety)	mature	implementing lessons
9	promote efficiency and safety	developing/ mature	implementing lessons
10	improve efficiency and prevent accidents (safety)	mature	implementing lessons
11	knowledge sharing of operations and safety (environmental)	developing/ mature	receiving lessons
12	knowledge sharing of operations	developing/ mature	none
13	improve efficiency of operations and knowledge sharing	developing/ mature	receiving lessons
14	knowledge sharing of operations and safety	new/ developing	receiving lessons
15	knowledge sharing to improve efficiency of operations	new/ developing	receiving lessons

Table IV-4 identifies the operational characteristics of the Lessons Learned Systems. These include identification of the Formality characteristic (formal or ad hoc), the Locus characteristic (centralized or distributed), the Process Relation characteristic (embedded or standalone) and the Acquisition characteristic (active or passive).

Table IV-4 Operational Characteristics of Existing Lessons Learned Systems

Key Code	Formality	Locus	Process Relation	Acquisition
1	formal	centralized	combination	combination
2	formal	centralized	embedded	active
3	ad hoc	centralized	standalone	passive
4	formal	centralized	combination	combination
5	formal	centralized	combination	combination
6	formal	centralized	combination	passive
7	ad hoc	centralized	standalone	passive
8	formal	centralized	combination	combination
9	formal	centralized	combination	combination
10	formal	distributed	combination	combination
11	formal	distributed	combination	combination
12	ad hoc	centralized	embedded	active
13	formal	distributed	standalone	passive
14	ad hoc	centralized	standalone	passive
15	formal	distributed	combination	passive

Table IV-5 below identifies the lesson characteristics of the Lessons Learned Systems. These include the Content characteristic (pure or hybrid) and the Process Type characteristic (technical, administrative or planning). It should be understood that most of the Lessons Learned Systems have some part of all the qualitative values. Table IV-5 represents a best effort predominant value based on the data on hand.

Table IV-5 Lesson Characteristics of Existing Lessons Learned Systems

Key Code	Content	Process Type
1	pure	planning/technical
2	pure	planning
3	pure	technical
4	pure	technical
5	pure	technical/planning
6	hybrid	technical/administrative
7	pure	technical
8	hybrid	technical
9	hybrid	technical
10	hybrid	technical
11	hybrid	technical
12	pure	planning/technical
13	pure	technical
14	pure	technical
15	pure	technical

Table IV-6 below identifies the organizational characteristics of the Lessons Learned Systems. These include the Interpretive Context characteristic (high, medium or low) and the Type characteristic (adaptable, rigid). Table IV-6 represents a best effort predominant value based on the data on hand.

Table IV-6 Organizational Characteristics of Existing Lessons Learned Systems

Key Code	Interpretive Context	Type
1	medium	rigid
2	low	rigid
3	medium	adaptable
4	medium	rigid
5	high	adaptable
6	medium	adaptable
7	medium	adaptable
8	medium	adaptable
9	medium	adaptable
10	medium	adaptable
11	medium	adaptable
12	medium	adaptable
13	medium	adaptable
14	medium	adaptable
15	medium	adaptable

Table IV-7 below identifies the organizational characteristics of the Lessons Learned Systems. These include the Resources available (high, medium or low) and Responsibility (high, medium or low). Responsibility is the level of responsibility that a Lessons Learned System holds for the accuracy of Lessons Learned disseminated. Table IV-7 represents a best effort based on the Organization and disclaimer, if existing.

Table IV-7 Other Organizational Characteristics of Existing Lessons Learned Systems

Key Code	Resources	Responsibility
1	medium/medium[140]	medium
2	medium/high	low
3	low	low
4	medium/high	high
5	medium/high	high
6	low/medium	medium
7	low	low
8	medium/high	medium
9	medium/high	medium
10	medium/high	medium
11	medium/high	low
12	medium	low
13	medium/high	medium (self imposed high)
14	low	low
15	medium	medium

[140] resources of Lessons Learned System/resources of parent organization

Table IV-8 below identifies key statements made by the Lessons Learned Systems. Table IV-8 does not contain all key statements and reference should be made to section B for those statements and for context of the statements below.

Table IV-8 Key Statements of Existing Lessons Learned Systems	
Key Code	**Statement**
1	biggest challenge is that change is implemented, the importance of chain of command in the process
2	policy makers are involved in the development of lessons learned report
3	most submissions of lessons have been those sought out
4	lessons gathering is mostly passive and there is concern that there are lessons learned that exist in the field that are not being obtained
5	lessons gathering relies on input from field, viewed by field as low priority (non management support), missed opportunities
6	concern of lessons being obtained, submitted voluntarily
7	included as part of review
8	importance of management support at all levels, make the system fit within the tools your workers use every day, lack of quality lessons equates to non use
9	quality of lessons equals continued usage, if safety involved, override time consuming review process, disseminate lesson with disclaimer, then follow up
10	lesson reviewed by subject matter expert for quality, requirement of an operational procedure is documenting lessons learned
11	simplicity and ease of use equals usage of system
12	lessons learned contractual requirement, collectors and policy makers writing lesson learned report together
13	proactive dissemination and implementation, organizational wide management support, technical expert reviews, high management endorsement, high quality lessons equal usage
14	limited lessons input , action to counter is outreach marketing plan and active search
15	passive system equals lesson population worries, usage a requirement of new products, user friendly information technology makes system feasible

D. CONCLUSION

The chapter contains the data collected about existing Lessons Learned Systems. It organized the data in a form that supports the methodology of Chapter III as implemented in Chapter V. Section B contained write-ups on the existing Lessons Learned Systems based on a questionnaire and e-mail and telephone follow-up. Section C organized the data in tables.

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V. ANALYSIS

A. INTRODUCTION

This chapter analyzes the data and answers the primary research question. The primary research question of this thesis is: How may a Lessons Learned System be characterized according to the handling of lessons processing, and how may such a characterization be applied to Lessons Learned System design or architecture?

The data is analyzed according to the methods outlined in Chapter III. Information on existing Lessons Learned Systems was presented in Chapter IV. The data was also organized in tables.

The definition for lesson in Chapter II was not consistent. The first task is to establish a definition for lesson so that the level of treatment identified in Chapter IV can be collected. The definition for lesson and thus the starting point for handling is established in Section B.

The next task is to determine the Handling Variable Set. This is done by collecting all handling methods and creating a "union" set. The "union" set or the Handling Variable Set is a set of handling methods such that any element of the set can be found in one of the Lessons Learned Systems of Chapter IV. The development of the Handling Variable Set is accomplished in Section C.

The final task will be to identify the cause and effect of handling methods and other influences, as viewed by the existing Lessons Learned Systems of Chapter IV, on the three tasks of a Lessons Learned System. The three tasks are collecting lessons, providing a quality lesson learned for dissemination and dissemination where implementation is the goal. This is done in Section D.

B. THE SCOPE OF THE HANDLING CHARACTERISTIC

The definition of lesson is not entirely consistent between the Army, the Department of Energy and a representative from the American Association for Artificial Intelligence. By strict definition, a lesson is something learned by study or experience.[141]

Army Regulation 11-33 does not specifically define a lesson but does define a lesson learned. A lesson learned is validated knowledge and experience derived from observations and historical study of military training, exercises, and combat operations.[142] At first glance, it would appear that the phrase lessons learned is redundant but there is a distinction that should be recognized. The use of "learned by study or experience" in the strict definition should be viewed as the consequence of an action. To expand, some action takes place and as a result there is some consequence of that action. Recognizing the connection between the action and its consequence is a lesson. The consequence may need to be refined in order to be of use in organizational learning. That is, it may need to be reduced to a root cause or determined if it is applicable on a more wide scale. This process would be the validation part of the Army definition of a lesson learned.

The reason for the effort in fine-tuning the definition of lesson is to identify more clearly where the characteristic of Handling begins. By interpreting a lesson as an experienced action and recognized consequence, the Handling characteristic can begin from the actions performed on the lesson from that point. This position may be somewhat awkward with regards to the characteristic Acquisition. It would seem logical that Acquisition would occur before Handling but this is not necessarily the case. A few of the existing Lessons Learned Systems receive Lessons Learned that have already undergone some form of Handling. For example, the Coast Guard - Standard After Action Information and Lessons Learned System acquires Lessons Learned after they have been command approved. To define Handling strictly as actions of a Lessons

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141 *Webster's Seventh New Collegiate Dictionary* (1972).

142 *Army Regulation 11-33, Glossary*

Learned System after Acquisition would remove the Handling events that should be considered, such as the command approval of Lessons Learned in the Coast Guard - Standard After Action Information and Lessons Learned System.

Army Regulation 11-33 defines an observation as raw information from any source which has not been refined through analysis.[143] Therefore, using Army language, a definition of Handling could be revised from "Handling refers to the level of treatment given a lesson after it has been generated" to "Handling refers to the level of treatment given an observation after it has been recognized."

The Department of Energy Standard DOE-STD-7501-99 December 1999 does not define lesson but it does define a Lesson Learned.

> A Lesson Learned is a good work practice or innovative approach that is captured and shared to promote repeat application. A lesson learned may also be an adverse work practice or experience that is captured and shared to avoid recurrence.[144]

Defining the generation of a lesson as a recognized action with its consequence and Handling as the actions that occur from that point on does not contradict the Department of Energy Standard DOE-STD-7501-99 December 1999 definition for a Lesson Learned.

It would not be consistent with the definition for a lesson introduced by Aha (2000). That definition for lesson is a validated record extracted from a (positive or failure) experience with a previous decision process that others in an organization can reuse to reinforce a positive result and/or avoid a failure.[145] This definition implies that some Handling has already occurred. There is the statement that the record has been validated and that others in the organization can reuse the lesson. To use this definition of a lesson in the definition of Handling would reduce the scope of what is considered the Handling level of treatment to those actions concerned with dissemination, such as editorial preparation and appropriate distribution.

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143 *Army Regulation 11-33, Glossary*

144 DOE-STD-7501-99.

145 Aha, D. W. (2000).

The subject of dissemination raises another question that should be addressed. When is the Handling aspect considered to be finished? Does it end when the lesson learned is disseminated or does handling include the actions after dissemination? Some existing Lessons Learned Systems perform actions after a Lesson Learned is disseminated. For example, the International Space Station Lessons Learned Database requires that groups who are sent a Lesson Learned respond as to how the Lesson Learned affects them and if so, what actions are being implemented to capitalize on the Lesson Learned.

To include the post-dissemination actions into the characteristic of Handling may expand the Handling characteristic to such a point that it would be difficult to provide a simple qualitative value to describe it. There is also a characteristic of Dissemination. It has qualitative values of active and passive. The post-dissemination actions could be included within the qualitative value of active.

Because of the two considerations above, the handling of lessons learned after dissemination will not be included within the Handling characteristic.

The scope of the Handling characteristic includes the level of treatment given a lesson from when a lesson is generated, where a lesson is an action/consequence experience, to the time when the lesson learned is disseminated.

C. THE HANDLING VARIABLE SET

The Handling Variable Set is determined by examination of Table IV-2. Handling methods are chosen and entered into Table V-1. The criteria for being chosen is that the method is an action performed by the Lessons Learned System on a lesson, where a lesson is an experience realized from an action and the action performed by the Lessons Learned System occurs from the time a lesson is realized to when it is disseminated. All the methods of Table IV-2 that meet the criteria are represented in Table V-1. To reduce the size of Table V-1, some methods are grouped together due to their similarity.

Actively searching for lessons was not included in Table IV-2. The reason being that this action belongs more to the Acquisition characteristic than to the Handling characteristic. It is dependent on the existence of another Lessons Learned System and is not an action of an independent Lessons Learned System.

Each action of the Lessons Learned Systems in Table V-1 is assigned a variable number. This number represents its value place of the Handling Variable Set. For example, variable number seven represents the ones place and variable number six represents the tens place.

Table V-1 Handling Variable Set	
Variable Number	**Description**
1	co-written at source by Lessons Learned System personnel
2	reviewed at source by supervisory personnel or command approved or preliminary level of review
3	reviewed centrally for technical adequacy by experts
4	verified by test, or feedback once disseminated
5	reviewed centrally for editorial adequacy (root cause, generic, background, public relations, relevancy, etc.)
6	reviewed centrally or otherwise by potential users/policy implementers prior to dissemination
7	identifies target for dissemination, may also require response

A Handling Variable Set can then be defined for a Lessons Learned System. The set consists of seven binomial numbers where a one represents that the Lessons Learned Handling characteristic includes the description and a zero indicates that it does not. A dash is inserted after the first and fifth digit for reasons that are apparent later. For example, a Lessons Learned System with a Handling set of 0-0001-00 would be a Lessons Learned System that passively accepts lessons learned, reviews editorially, then disseminates in a general fashion.

Table V-2 below demonstrates how a Lessons Learned System may be characterized according to the handling of lessons processing, the first part of the primary research question. The Key Code numbers are from Table IV-1.

Table V-2 Handling Variable Set for Existing Lessons Learned Systems	
Key Code	**Handling Variable Set**
1	0-1001-01
2	1-0101-10
3	0-0001-00
4	0-1111-01
5	0-1111-01
6	0-1001-00
7	0-0001-00
8	0-1101-00
9	0-0111-00
10	0-1101-00
11	0-1001-00
12	1-1001-10[146]
13	0-1111-11
14	0-0000-00
15	0-1001-10

[146] In analyzing this Lessons Learned System, the hired consultants are considered as Lessons Learned System agents and their actions are the actions of the Lessons Learned System

D. ASPECTS OF LESSONS LEARNED SYSTEM DESIGN

In Chapter II, three tasks or requirements were identified for a Lessons Learned System. These were receiving lessons, insuring that lessons learned are of high quality and dissemination leading to implementation.

1. Receiving Lessons

A number of existing Lessons Learned Systems identified a concern about receiving lessons learned. From Table IV-3, these were Key Codes 3, 4, 5, 6, 11, 13, 14 & 15.

These Key Codes were at varying stages of development and there was no definite correlation between being new and a concern about receiving lessons learned.

There was a connection between the Acquisition characteristic and the concern for receiving lessons learned. From Table IV-4, Key Codes 3, 4, 5, 6, 11, 13, 14 & 15 had an Acquisition characteristic qualitative value of passive or combination. Those having a qualitative value of combination, Key Codes 4 & 5, identified that their active portion, although existing, was weak. There was a direct correlation between a concern for receiving lessons learned and an Acquisition characteristic qualitative value of passive. This finding supports the literature review statement "information, you have to get it yourself." See Table II-2.

Some of the Key Codes that had a concern about receiving lessons learned had an Operational Process Relation characteristic qualitative value of embedded or combination. These were Key Codes 4, 5, 6, 11 & 15. There were two reasons why an embedded qualitative value of the Process Relation characteristic did not guarantee a quantity of lessons learned. There were two cases, Key Codes 11 & 15 where the Lessons Learned System was part of a distributed system and there was a voluntary or passive requirement to submit the lessons learned. The second case, Key Codes 4, 5 & 6 depend on lower management enforcement on completing lessons learned paperwork. These findings support the literature review statement "performing work and asked to

record lessons while doing so is unlikely to be successful" and the importance of "management support and involvement." See Table II-2.

Upper management support by vocalization was also mentioned as having a positive effect on the generation of lessons learned as was incentives to contribute (Key Code 13). The positive effects of these were cited as not being permanent effects. Again this supports the literature position of the importance of management support.

Key Codes 1, 2, 8, 9, 10 & 12 did not have a concern about receiving lessons learned. The Lessons Learned System of Key Code 7 is a secondary concern and therefore Key Code 7 cannot relate experience.

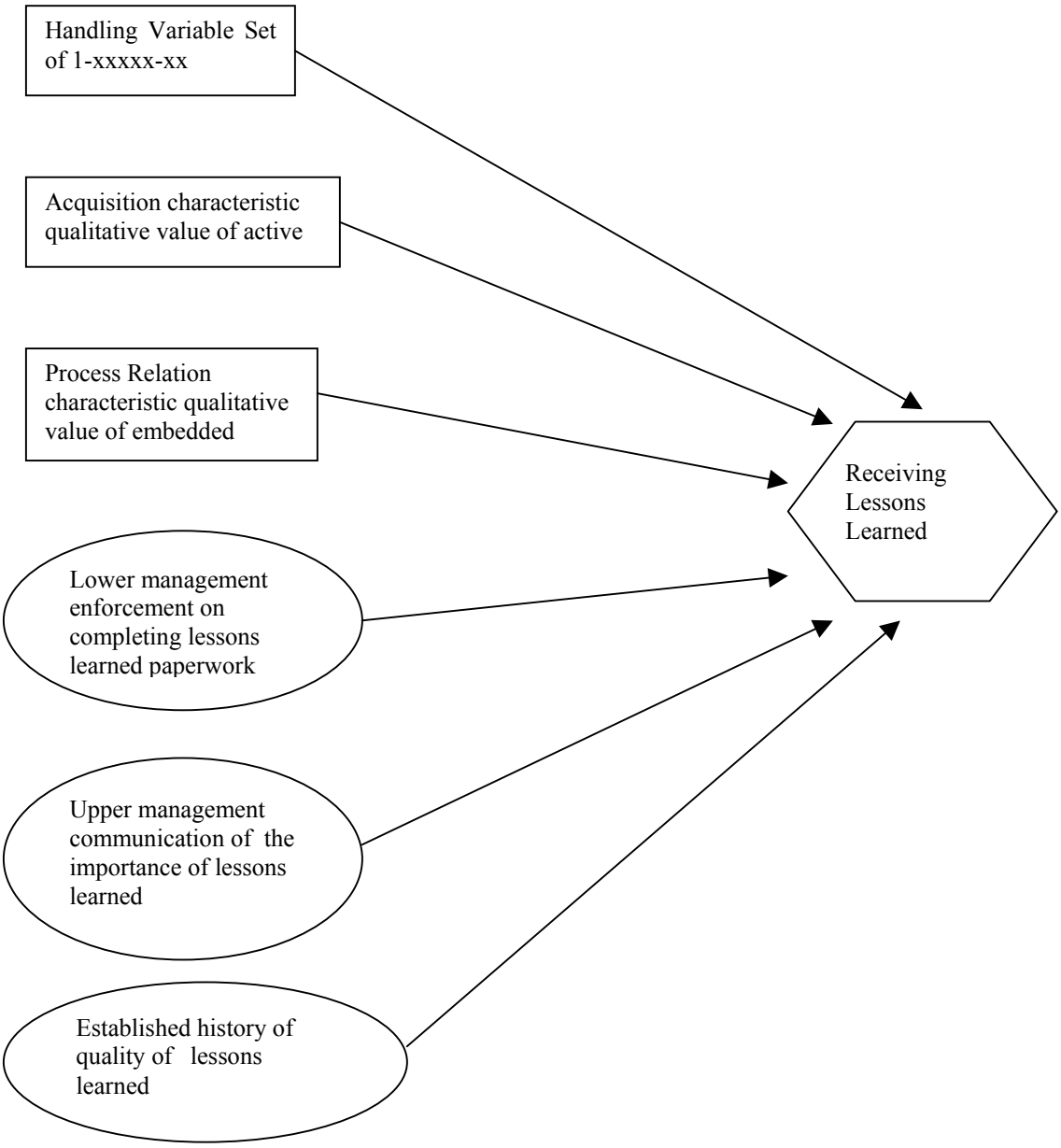
Key Codes 2 & 12 have a Handling Variable Set first digit of 1. This designates that the Lessons Learned are co-written at the source by Lessons Learned System personnel. This represents the combination of an Acquisition characteristic of active and a possible interpretation of the Process Relation characteristic of embedded. A Lessons Learned System with a Handling Variable Set of 1x-xxx-xx will promote the receiving of lessons learned. This finding also supports the literature review statement "information, you have to get it yourself." See Table II-2.

Key Codes 1, 8 & 10 are at a mature development stage and have high upper management support along with a combination (including embedded for embedded/standalone and active for active/passive) for the Process Relation characteristic and the Acquisition characteristic.

Key Codes 1, 8, 9 & 13 are mature or developing/mature Lessons Learned Systems. These four Key Codes cited the importance of quality lessons learned to the value or usage of the Lessons Learned System. It may be concluded that an established history of quality lessons learned will increase usage including the submission of lessons learned.

The Influence Diagram below graphically displays influences on the receiving of lessons learned for a Lessons Learned System. Refer to the Chapter III for the meaning of symbols.

Figure V-1 Receiving Lessons Learned Influence Diagram



2. Quality of Lessons Learned

No existing Lessons Learned System identified a concern about the quality of the Lessons Learned that they disseminate.

Chapter IV identified a number of methods used to review lessons learned prior to dissemination to insure quality. These included:

1. Reviewed at source by supervisory personnel or command approved or preliminary level of review.

2. Reviewed centrally for technical adequacy by experts.

3. Verified by test, or feedback once disseminated.

4. Reviewed centrally for editorial adequacy. This included root cause analysis, generic filtering, context and background for understanding, relevancy and public relations.

These have been incorporated into the Handling Variable Set as digits 2 thru 5. See Table V-1.

The choice of the quality values (0 or 1 for digits 2 thru 5) for the Handling Variable Set for Lessons Learned System design needs to be fit for the specific Lessons Learned System.

The first quality digit (digit 2 of the Handling Variable Set), reviewed at source by supervisory personnel or command approved or preliminary level of review, is implemented (value of 1) by military Lessons Learned Systems (Key Codes 1, 4, 5 & 6) and Lessons Learned Systems that act as a collecting point for distributed sources (Key Codes 10, 11, 13 & 15). The benefits of implementing the choice are obtaining lessons that meet a certain criteria such as being influenced by a narrow application or a specific agenda (Key Code 1), categorization (Key Code 13) and accuracy (Key Codes 6 & 15).

The second quality digit (digit 3 of the Handling Variable Set), reviewed centrally for technical adequacy by experts, is implemented (value of 1) by Lessons Learned Systems (Key Codes 4, 5, 8, 9, 10 & 13) that deal with a subject that requires a special knowledge to properly evaluate. These include engineering (Key Codes 4 & 13), medical

(Key Code 5) and nuclear (Key Codes 8, 9 & 10). Organizations whose subjects are specialized should implement a review by experts to provide assurance of quality.

The third quality digit (digit 4 of the Handling Variable Set), verified by test, or feedback once disseminated, is implemented (value of 1) by Lessons Learned Systems (Key Codes 4, 5, & 13) whose subjects are such that confirmation by test is beneficial and feasible. The implementation of engineering (Key Codes 4 & 13) and medical (Key Code 5) solutions cannot always be guaranteed by analysis alone and often empirical data is needed. Verifying by test is not always feasible with some engineering fields such as nuclear, where minimizing human interaction with nuclear materials is prudent. Key Codes 8, 9, 10, 11 & 13 (in part) are involved with the nuclear subject and do not verify accuracy or quality by test. Key Code 9 does monitor for feedback or accuracy once disseminated. The implementation of verified by test (where feasible), or feedback once disseminated, will provide assurance of accuracy and quality.

The final quality digit (digit 5 of the Handling Variable Set), reviewed centrally for editorial adequacy (root cause, generic, background, public relations, relevancy, etc.), is implemented (value of 1) by all the existing Lessons Learned Systems except one (Key Code 14). Key Code 14 is a new Lessons Learned System and is attempting to develop quality by open (through web site postings) discussion. To insure some level of accuracy and quality, the Lessons Learned System should implement an editorial review. This finding supports a number of literature statements. See Table II-2.

The above provides guidance on choosing the Handling Variable Set to meet quality needs. To characterize the level of quality implemented by Lessons Learned Systems through the Handling characteristic in a more general sense, the quality digits of the Handling Variable Set can be added to give a general level. For example, Key Code 5 with a Handling Variable Set of 0-1111-01 can be condensed to 0-4-1 or 041 indicating a high degree of effort concerning quality. Key Code 3 with a Handling Variable Set of 0-0001-00 can be condensed to 0-1-0 or 010 indicating a lesser effort concerning quality.

As a general observation, Chapter IV provided three criteria that could influence the choice of quality values for the Handling Variable Set. These included the goals of

Lessons Learned System, resources available to the Lessons Learned System and responsibility level of the Lessons Learned System.

Table V-3 below lists qualitative values for the three criteria. The information was abstracted from Tables IV-3 and Table IV-7.

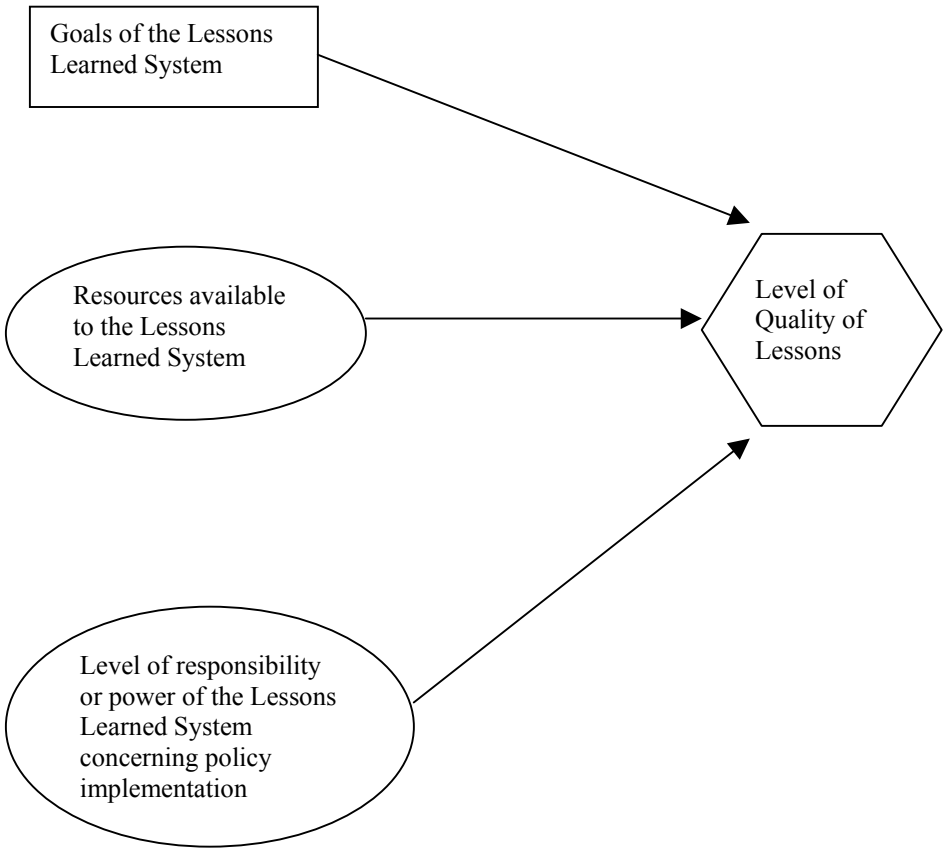
Table V-3 Quality Influences of Existing Lessons Learned Systems					
Key Code	**Handling Variable Set**	**Quality Sum**	**Goal**	**Resources**	**Responsibility**
1	0-1001-01	2	operational	medium	medium
2	1-0101-10	2	operational	medium	low
3	0-0001-00	1	safety	low	low
4	0-1111-01	4	engineering	medium	high
5	0-1111-01	4	medical	medium	high
6	0-1001-00	2	operational	low	medium
7	0-0001-00	1	operational	medium	low
8	0-1101-00	3	nuclear safety	medium	medium
9	0-0101-00	2	nuclear safety	medium	medium
10	0-1101-00	3	nuclear safety	medium	medium
11	0-1001-00	2	nuclear safety	medium	low
12	1-1001-10[147]	2	operational	medium	low
13	0-1111-11	4	engineering	medium	medium
14	0-0001-00	1	operational	low	low
15	0-1001-10	2	engineering	medium	medium

[147] In analyzing this Lessons Learned System, the hired consultants are considered as Lessons Learned System agents and their actions are the actions of the Lessons Learned System

Table V-3 indicates that Lessons Learned Systems whose goal is medical or engineering, have high level of responsibility or involvement in policy implementation and have available resources have the highest general level of quality review. It also shows that the absence of one criterion (subject, resources & responsibility) results in reduced levels of handling in terms of quality of lessons. Key Code 13 has made the quality of lessons a self imposed requirement.

This can be graphically displayed in an Influence Diagram. Refer to the Chapter III for the meaning of symbols.

Figure V-2 Influences on the Level of Quality Review



The design of the Handling characteristic of a Lessons Learned System for quality is first based on the level required per the criteria of Figure 2. Once the level is established, the methods of handling associated with quality of the Handling Variable Set can be chosen where feasible.

The particulars of the editorial review must be fitted to the uniqueness of the organization.

3. Implementation of Lessons Learned

There are two methods of handling identified in Table IV-2 that support implementation of Lessons Learned. These are:

1. Reviewed centrally or otherwise by potential users/policy implementers prior to dissemination.
2. Identifies target for dissemination, may also require a response.

These have been incorporated into Table V-1 variable numbers six and seven.

Key Code 12 identified that it had no present concerns, that it was satisfied with the implementation of its Lessons Learned, see Table IV-3. A review of its Handling Variable Set, see Table V-1, indicates a 1 for the sixth digit signifying that lessons are reviewed centrally or otherwise by potential users/policy implementers prior to dissemination. Key Codes 13 & 15 also implements this handling method. Key Code 13, in Chapter IV states that there is a credibility that exists when the management board endorses a lesson and this encourages … use.[148] Key Code 15, in Chapter IV, states, there is evidence that the database is being addressed by the … for lessons learned.[149] Key Codes 13 & 15 do not have a concern about the implementation of lessons learned.

The remaining Key Code where lessons are reviewed centrally or otherwise by potential users/policy implementers prior to dissemination is Key Code 2. Key Code 2 has a present concern of implementing lessons. It is identified in Chapter IV that one purpose of their Lessons Learned System is to provide the lessons learned to policy

[148] see page 75

[149] see page 79

makers who can implement the lessons learned. This is done by policy makers participating in the validation process.[150]

There is evidence that a Lessons Learned System employing a Handling Variable Set where the sixth digit is one, reviewed centrally or otherwise by potential users/policy implementers prior to dissemination, will have a positive effect on an organization implementing their Lessons Learned. This finding supports the literature statements about "management support and involvement" and "users participate in process/design." See Table II-2.

Key Codes 3, 6, 8, 9, 10, 11 & 14 have zeros for the sixth and seventh digit of the Variable Handling Set, see Table V-2. A one for digit seven represents the Lessons Learned System identifying a target for dissemination, may also require response. Key Codes 8, 9 & 10 identified their present concern as implementing lessons, see Table IV-3. Key Codes 3, 6, 11 & 14 did not identify their present concern as implementing lessons but rather receiving lessons. Key Codes 3, 6 & 14 have an Acquisition characteristic of passive, see Table IV-4. Key Codes 3, 6, 11 & 14 also have a 0-xxxx-xx Handling Variable Set, see Table V-2, so having a present concern of receiving lessons and not implementing lessons may be a case of one before the other.

Key Code 1 is a Lessons Learned System that has a one in the seventh digit and also identified implementing lessons as its present concern, see Table V-2 and Table IV-3. It is noted that Key Code 1 could be classified as having a rigid qualitative value for the Organizational Type characteristic, see Chapter II, Section E. This implies that the concern of implementing lessons may be more dependent on the Organizational Type characteristic than on handling aspects.

Key Code 13 is a Lessons Learned System that has a one in the seventh digit, see Table V-2. Key Code 13 identified in Chapter IV that their identification of a target for dissemination, a one for digit seven of the Handling Variable Set, includes pro-active involvement. The target is required to respond and the movement of the Lessons Learned is tracked to insure required actions are taken. This finding supports the literature statement about "management support and involvement." See Table II-2.

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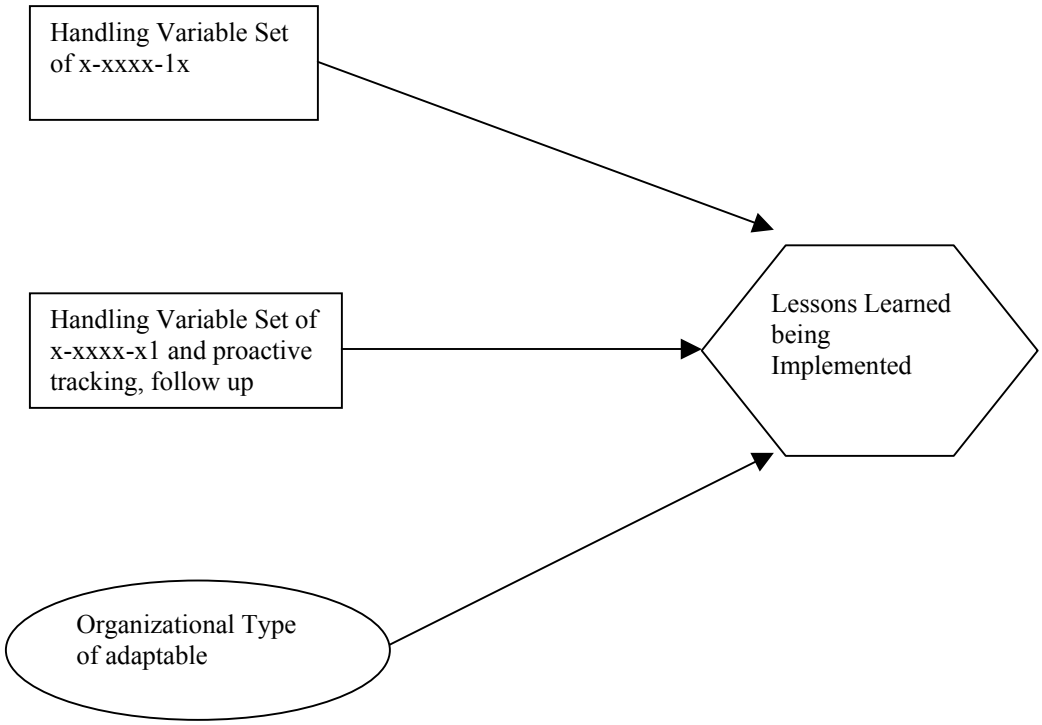
[150] see page 56

The influence diagram below graphically displays influences on the implementation of lessons learned for a Lessons Learned System. Refer to the Chapter III for the meaning of symbols.

Figure V-3 Implementing Lessons Learned Influence Diagram



4. Summary

Sections 1 Receiving Lessons, Section 2 Quality of Lessons Learned and Section 3 Implementation of Lessons Learned have provided guidance for Lessons Learned Systems designers in the areas of receiving lessons, insuring that lessons learned are of high quality and the usage or implementation of lessons learned with an emphasis on the Handling characteristic.

E. CONCLUSION

The primary research question of this thesis is: How may a Lessons Learned System be characterized according to the handling of lessons processing, and how may such a characterization be applied to Lessons Learned System design or architecture?

Section C provided a coding of existing handling methods. The coding is a seven-digit number, expressed x-xxxx-xx, where a one represents an action and a zero represents omission. The separation by dashes allows the handling to be decomposed into actions that affect receiving lessons, quality of lessons and handling lessons concerning implementation. The coding can further be condensed by adding the values of the separated section to form a three-digit number. For example a Handling Variable Set of 1-1010-10 can be condensed to 1-2-1 or 121. This would provide a quick measure of the effort of quality. This coding, the Handling Variable Set, provides one answer to: How may a Lessons Learned System be characterized according to the handling of lessons processing?, the first part of the primary research question.

Section D provided qualitative analysis based on existing Lessons Learned Systems to answer the second part of the primary research question: how may such a characterization be applied to Lessons Learned System design or architecture? The analysis provided the effects of the Handling Variable Set on receiving lessons, quality of lessons learned and implementation of lessons learned.

For receiving lessons, Figure V-1 provided a cause and effect relationship between the Handling Variable Set and receiving lessons.

For the quality of lessons, Figure V-2 provided an estimate of what an appropriate level of quality should or could be. The Handling Variable Set, particularly the quality section, can then be examined against this level.

For implementation of lessons learned, Figure V-3 provided a cause and effect relationship between the Handling Variable Set and the implementation of Lessons Learned.

The combined use of the Handling Variable Set and Figures V-1, V-2 and V-3 can be used toward Lessons Learned System design or architecture.

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VI. APPLICATION TO SUPSHIP GROTON

A. INTRODUCTION

This chapter applies the characterization of lessons handling and its application to design to the SUPSHIP Groton Lessons Learned System. The SUPSHIP Groton Lessons Learned System is a new developing system. The background for the SUPSHIP Groton Lessons Learned System is provided in Section B.

A characterization of lessons handling is the Handling Variable Set as was developed in Chapter V. The Handling Variable Set and the Influence Diagrams of Chapter V can be used to evaluate the design or architecture of a Lessons Learned System with respect to its basic tasks. The basic tasks are receiving lessons, developing a quality lesson for dissemination, and dissemination with the goal of implementation.

Section C provides the analysis and Section D provides recommendations based on the analysis and additional recommendations based on Chapters II and IV.

B. SUPSHIP GROTON LESSONS LEARNED SYSTEM

SUPSHIP Groton is a Naval Sea Systems Command (NAVSEA) field organization located in Groton, CT. SUPSHIP Groton represents NAVSEA and oversees nuclear submarine design, new construction and submarine repair efforts of the Electric Boat Corporation.[151]

Past practice had been for NAVSEA to send a team to SUPSHIP Groton to audit SUPSHIP Groton operations. The audit could concentrate on any area. A few years ago, NAVSEA began an initiative to align its operations at headquarters and at field offices more closely with the best business practices of the private sector. As a consequence, the audits were supplemented with a NAVSEA evaluation of SUPSHIP Groton to the criteria of the Baldrige National Quality Program. For SUPSHIP Groton, this included a Unit Self Assessment and a Command Performance Inspection.

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[151] SUPSHIP Groton Instruction 5224.1 of 28 Feb 02

As a result of a self-analysis, it was concluded that SUPSHIP Groton could improve in the area of Customer and Market Focus, particularly in Customer Relations. As a result, a Customer Focus Policy was issued to address this improvement. Part of the improvement policy was the development of an evaluation process entitled AFTER (After the Fire Take Time to Evaluate and Review).

AFTER is a structured post crisis or post key event evaluation with the goal of capturing what SUPSHIP Groton did right and where efforts need improvement. The goal of AFTER is to ensure what SUPSHIP Groton did well during the "fire" is embedded in our normal work processes and to modify any aspect of SUPSHIP Groton operation or process to improve future performance.[152]

This fits the general definition of a lessons learned system. The judgement of doing well or not doing well is based on customer satisfaction. A complaint or dissatisfaction by the customer would be a negative experience. Likewise, a satisfied customer would be a success. AFTER is new and is still under development with many details of operation needed to be determined. There are no procedures for operation. There is only a temporary repository for "lessons", that being Word software. The details of dissemination and implementation have not been worked out.

AFTER has not yet been used. The Customer Focus Policy includes other programs to promote customer relations. These have begun to operate and customer input has been collected and although SUPSHIP Groton personal have addressed the specific customer complaints, no root cause or general lesson learned that could be used to determine correct processes have been determined from the complaint.

SUPSHIP Groton customers include NAVSEA Washington DC Corporate Headquarters, Program Executive Offices, Commander Submarine Force, U.S. Atlantic Fleet, the Officers and Crews of pre-commissioned submarines under construction at Electric Boat, the Officers and Crews of commissioned submarines in overhaul or repair

[152] SUPSHIP Groton Instruction 5224.1 of 28 Feb 02

at Electric Boat and at the Naval Submarine Base New London, Groton, CT under Electric Boat contract and Naval Laboratories.[153]

AFTER is not a continuous operating system. The system is initiated by management calling for AFTER action. It is planned that this calling for action will be after an unusual event that required unplanned SUPSHIP Groton action or a key event such as the completion of an overhaul, a design review, etc. The basic process is first a meeting to discuss lessons learned from the action or involvement in a key event. This meeting is to include solicited dispositions and interviews from the customers that were involved. A report is written containing the findings and posted on the SUPSHIP Groton Intranet. The report will include specific action items or recommendations for study.

As stated earlier, the AFTER system has yet to be implemented. It is expected that the process will be adjusted as experience with the AFTER system is gained.

C. ANALYSIS

The first task of the analysis is to determine the Handling Variable Set for the SUPSHIP Groton Lessons Learned System. From the description in Section B, the Handling Variable Set is 0-0001-10. This corresponds to a Lessons Learned System where lessons are not co-written at source by Lessons Learned System personnel, there is no preliminary supervisory approval, no review by experts as to accuracy, no verification by test and no target for dissemination requiring a response. There is a central review for accuracy by potential policy makers prior to issuing a report.

The second task is to use the Handling Variable Set and the Influence Diagrams of Chapter V to predict the performance of the SUPSHIP Groton Lessons Learned System with respect to the three basic tasks of a Lessons Learned System. The three tasks are receiving lessons, developing quality lessons prior to dissemination and disseminating lessons with the goal of implementation.

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[153] SUPSHIP Groton Instruction 5224.1 of 28 Feb 02

1. Receiving Lessons

From Figure V-1, due to an absence of a one in the first digit of the Handling Variable Set, the empirical evidence suggests that the SUPSHIP Groton Lessons Learned System will experience a concern about receiving lessons. Reliance on the customer retaining the lessons until the meeting or the local SUPSHIP supervision collecting lessons as a collateral duty will not be sufficient. This was suggested in Chapter II, see the Table II-2, and supported empirically in Chapter V, Section D.1.

The characteristic Acquisition describes how lessons are obtained. A Lessons Learned System with an Acquisition characteristic qualitative value of active seeks out lessons by incorporating itself into the organization's operations or other active searches. Although the SUPSHIP Groton Lessons Learned System does actively search for lessons by interviewing the customer, because the interview may be some time after the events, the Acquisition qualitative value of active cannot be considered a strong value. Without a strong or certain value of active, Figure V-1 implies that receiving lessons may be a concern.

The characteristic of Process Relation is a measure of how integrated the Lessons Learned System is with an organization's operation. A qualitative value of embedded requires as part of operations the recording of lessons learned. The SUPSHIP Groton Lessons Learned System is not embedded but is standalone. Figure V-1 implies that receiving lessons may be a concern.

The other influences affecting receiving lessons from Figure V-1 are Lower management enforcement on completing lessons learned paperwork, Upper management communication of the importance of lessons learned and Established history of quality of lessons learned. These are not decision variables available to the Lessons Learned System and are outside or environment influences, see Table II-1. The first influence is not applicable as there is no lesson learned paper work, as there would be with a Lessons Learned System with an embedded qualitative value for its Process Relation characteristic. The second influence has not occurred as yet and the third influence is not applicable due to the newness of the SUPSHIP Groton Lessons Learned System. Therefore, these cannot have a positive influence on receiving lessons.

Based on the Figure V-1 Influence Diagram and the Handling Variable Set, the analysis suggests that receiving lessons will be a concern.

2. Quality of Lessons Learned

The level of quality required or possible by a Lessons Learned System is first determined by the use of Figure V-2. A low value of any of the three influences will predict a lack of high quality. The two environmental influences from Figure V-2 are Resources available to the Lessons Learned System and Level of responsibility or power of the Lessons Learned System concerning policy implementation. Since these are probably moderate at best, the quality may not be high. With respect to the two influences above, a moderate level would be employees participating in the Lessons Learned System as collateral duty with little guarantee that their products will be used.

The third influence is the goals of the Lesson Learned System, a decision variable. The interpretation of goals in Figure V-2 was based on the subject of the lessons. Lessons Learned Systems dealing with medical, engineering and nuclear had a high level of quality development. This was required based on the consequences of inaccuracy. The SUPSHIP Groton Lessons Learned System has not clearly defined the subject matter that it will be concentrating on, only customer satisfaction. Since the subject matter may likely be operational, a high level of quality development may not be necessary.

Based on Figure V-2, the quality of lessons required may not be great, from a relative point of view.

The Handling Variable Set, 0-0001-10, with a quality section of 0001, is probably acceptable. This corresponds to an editorial type review. The omission of a prior command approval, verification by technical experts and verification by test is probably acceptable.

The use of experts to provide accuracy in technical areas is an available resource for the SUPSHIP Groton Lessons Learned System and would probably be implemented if necessary. Since the goal of the SUPSHIP Groton Lessons Learned System is customer

satisfaction and the customer is a member of the review team, quality of Lessons Learned in terms of accuracy should not be a concern.

An editorial review alone may provide quality lessons but is dependent on the editorial review being of high quality itself. The Handling Variable Set and Figure V-2 do not provide guidance or evaluation on what is a high quality editorial review because a high quality review is so dependent on being fitted to the uniqueness of the Lessons Learned System subject matter, its goals and its organization. This is further discussed in Section E.

3. Implementation of Lessons Learned

From Figure V-3, and a one in the sixth digit of the Handling Variable Set signifying reviewed by policy implementers, the implementation of lessons learned should not be a problem. A one in the sixth digit of the Handling Variable Set is a strong indicator, both theoretically and empirically, that Lessons Learned will be implemented.

A one in the seventh digit indicates that a Lessons Learned System identify a target for dissemination and may also require response. The Handling Variable Set for the SUPSHIP Groton Lessons Learned System is a zero for the seventh digit. This omission will not have a positive effect on the implementation of lessons.

The lone environmental factor effect the implementation of lessons, from Figure V-3 is the Organizational Type characteristic. SUPSHIP Groton is judged not to be rigid, therefore the Handling Variable Set influences on the implementation of lessons will not be countered.

Based on the Handling Variable Set and Figure V-3, the implementation of lessons is probably not a concern. The probability of lessons being implemented could be higher if the SUPSHIP Groton Lessons Learned System incorporated the practice of identifying targets for dissemination and requiring a response.

D. RECOMMENDATIONS

In fairness to SUPSHIP Groton, the intent of AFTER may not to be a Lessons Learned System but only one process in a total plan to increase SUPSHIP Groton efficiency and customer satisfaction. The following recommendations, though, are based on the intent of AFTER being a Lessons Learned System.

Without the benefit of operating experience and for a first effort design, the SUPSHIP Groton Lessons Learned System is a fairly good design. In its simplicity, it has incorporated methods (particularly lessons being reviewed by policy implementers prior to dissemination) that empirical evidence suggests is beneficial to a Lessons Learned System Success. However it is likely that not all appropriate lessons will enter the system.

1. Recommendations Based on Analysis

The recommendation is that SUPSHIP Groton establish a position whose responsibility it is to collect lessons learned as a sole activity on a daily basis from the different activities that are occurring. Along with this, it is necessary that management communicate that minor infringements to occurring work activities are necessary for long-term growth.

Actively collecting lessons in this manner will assure lessons are received into the system and coupled with the existing SUPSHIP Groton Lessons Learned System architecture, the SUPSHIP Groton Lessons Learned System should be successful.

Expending resources for this recommendation may be a concern. In support of the expenditure is the argument that modern businesses view Knowledge Management (of which a Lessons Learned System is a part) and Organizational Learning as essential to increased efficiency and competitiveness in the business world. If resources are limited, it is suggested that the collection of lessons as a collateral duty by local SUPSHIP supervision for an activity or an event be proactively enforced by management.

There are no recommendations based on the analysis concerning quality of lessons. The use of editorial review is considered sufficient to provide adequate quality for the intended purpose of the lessons. Again, the use of experts to provide accuracy in technical areas is an available resource for the SUPSHIP Groton Lessons Learned System and would probably be implemented if necessary.

The implementation of lessons should not be a major concern. The use of policy implementers to review the lessons and write the report is a positive influence on the implementation of lessons. The probability that lessons would be implemented can be increased though by targeting places of dissemination and requiring a response and should be a consideration.

2. Other Recommendations

The Handling Variable Set and the use of the Influence Diagrams for analysis and design or architecture is predominantly focused on the Handling characteristic. There are other aspects of design, beyond the Handling characteristic, that should be considered. Further, the details of the editorial review for quality, are also beyond the scope of the Handling Variable Set and the use of the Influence Diagrams. Fortunately, the information in Chapters II and IV can be used to provide guidance and other recommendations.

The editorial process used to provide quality of lessons needs to be specifically fit to the organization and the subject. The first task is to focus on the subject. The present plan is to query the customer on what SUPSHIP Groton did well and did not do well in performing some service to the customer. Once these are received, they must be filtered to determine if there is a root cause that can be addressed or if it is an isolated incident. If there is a root cause then there can be a change that will prevent the same problem in the future.

A solution to the root cause is not an easy task and may be more of an art than a science. An assumption that must be made is that someone in the organization knows the solution and it's a matter of finding that person. For example, a customer may state that the turnaround time on technical documents is too long. From a manager's perspective,

the root cause may be too long a time to transfer the technical documents from point to point along the approval path and suggest quicker electronic transfer methods as the solution. A person working the technical document may see the root cause as lack of information transfer. For example, a customer may perform a determination as to who is the approval authority for a technical document but only include the conclusion in the technical document leaving the receiver of the technical document to repeat the exercise to satisfy his management of the conclusion. Or the customer may after painstakingly navigating through many narrow computer screen views of an electronic drawing to find a detail, only cite the drawing and force the receiver of the technical document to repeat the tedious work that has already been done but not transferred. Once the person or collection of people who know the root cause or a potential solution to a customer concern is identified, then the solution must be transformed from tacit to explicit knowledge so that it can be transferred to the organization.

Explicit knowledge is written knowledge or perhaps video knowledge. Suggestions from Chapters II and IV to make knowledge more explicit is to provide context and remove irrelevancy. This is subjective though, as the goal of explicit knowledge is to develop tacit knowledge in the receiver and the correct explicit form ti initiate this is probably different for different receivers. The SUPSHIP Groton Lessons Learned System does not presently identify or target a receiver.

The above involves the quality of lessons.

The present plan for the SUPSHIP Groton Lessons Learned System is to collect Lessons Learned in a report. Although the report is planned to be written by policy implementers which empirical evidence indicates promotes implementation, there may be some policy implementers that are not involved and desired implementation by these may not occur.

Adopting the International Space Station method of targeting the lesson learned to a policy maker and requiring a response is a method that further promotes implementation. This should be done with a software that is comfortable to the receiver as suggested in Chapter IV.

One suggestion from Chapter II is that a Lessons Learned System be embedded in the operations of the organization.[154] A suggestion from Chapter IV is to make the Lessons Learned System fit with the tools your workers use every day.[155] An implication of these suggestion is that the Lessons Learned Systems be continuously operating. It is recommended that the SUPSHIP Groton Lessons Learned System be a continuously operating system and not just called into operation when desired.

Chapters II and IV also suggested the importance of information technology.[156] The SUPSHIP Groton Lessons Learned System currently uses Word software to retain lessons. This software has advantages in terms of familiarity and its inherent word processing. However it lacks in its ability to search or query. It is recommended that the Lessons Learned be retained in Word but that they be serialized and Access software be used to create a database of these Lessons Learned that can be queried as to subject, etc. so they may be found and applied as reference for future work endeavors.

E. CONCLUSIONS

This chapter demonstrated the characterization according to the handling of lessons processing of a Lessons Learned System by a Handling Variable Set and its application to Lessons Learned System design or architecture by use of the Influence Diagrams for a new developing Lessons Learned System. The proposed design is evaluated against the tasks of a Lessons Learned System. Those tasks are receiving lessons, developing quality of the lessons prior to dissemination and dissemination with the goal of implementation. Also included was a broader evaluation based on Chapters II and IV.

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[154] see page 18

[155] see page 67

[156] see pages 16 and 72

The result of the analysis is that AFTER, although not intended to be a complete Lessons Learned System, has a fairly good design, except possibly there will be a concern about receiving lessons. The recommendations may help the design, but pragmatically should only be considered after operation experience suggests improvement is needed, particularly concerning the recommendation about receiving lessons, as the recommendations would require resources.

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VII. CONCLUSION

A. THE PRIMARY RESEARCH QUESTION

The primary research question is: How may a Lessons Learned System be characterized according to the handling of lessons processing, and how may such a characterization be applied to Lessons Learned System design or architecture?

One method of characterizing the handling of lessons processing is by the Handling Variable Set. This coding encompasses the combinations of activities associated with the handling of lessons processing. It is not qualitative in nature by itself but allows a condensation of what could be a large qualitative description. This coding separates actions that effect the three tasks of a Lessons Learned System.

It was found that some handling actions effect receiving lessons, some effect the quality of the lessons and some effect implementation after dissemination. Two of the Influence Diagrams of Chapter V provide the cause and effect relationship that exists between the Handling Variable Set and the tasks of receiving lessons and implementation after dissemination. The third Influence Diagram of Chapter V provides a guide to the appropriate level of quality.

The level of quality and the methods of obtaining quality are dependent on the organization and the subject of its lessons. There are some general rules for quality and these have been expressed in Chapter VI.

The Handling Variable Set and the Influence Diagrams of Chapter V allow the characterization to be used in Lessons Learned System Design or architecture, the second part of the primary research question. This was demonstrated in Chapter VI.

B. LIMITATIONS OF THE RESEARCH

The research was based on a sample of Lessons Learned Systems. It is unknown to what degree this sample represents the whole of Lessons Learned Systems. Further the data was based on the Lessons Learned System's point of contact personnel experiences or opinions and did not necessarily represent the respective organization's official position.

The abstraction of data was subjective as it was of a qualitative nature. Lessons Learned Systems point of contact were given the opportunity to review the Lessons Learned Systems write-ups of Chapter IV systems and concurrence was obtained (Key Codes 1, 4, 5, 6, 8, 9, 11, 12, 13, 14) in all cases except where there was no response (Key Codes 2, 3, 7, 10 & 15). No attempt was made to obtain concurrence with findings regarding the analysis.

C. RECOMMENDATIONS FOR FUTURE RESEARCH

There are a few avenues for future resource.

1. The number of Lessons Learned Systems could be increased to either support the findings of the analysis (Influence Diagrams) and/or expand/revise the Handling Variable Set.

2. The other characteristics such as Acquisition could be transformed into Variable Set such as an Acquisition Variable Set and the Influence Diagrams could be expanded/revise to include any influences.

3. The Handling Variable Set and other Variable Sets and environmental effects could act as input into an equation whose computed value corresponds to a level of success of one of the three tasks (receiving lessons, quality of lessons and implementation of lessons). The coefficients of the equation is what is to be determined.

4. Key Code 13, the International Space Station Lessons Learned Database, probably has the best methods of Lessons Learned implementation and would be a good case study.

5. Although there are other good Lessons Learned systems in Chapter IV, Key Code 8, Department of Energy Project Hanford Lessons Learned System, would be a good case study for overall operations.

D. CONTRIBUTION TO THE BODY OF KNOWLEDGE

The first purpose of this thesis was to increase the body of knowledge that exists for Lessons Learned Systems. This thesis has contributed to the body of knowledge that exists for Lessons Learned Systems by first providing information regarding the mechanics and experiences of fifteen existing Lessons Learned Systems. This information found in Chapter IV was provided by Lessons Learned System point of contacts who have a high level of experience. Although specific questions were asked and answered relating to the analysis section of this thesis, the point of contacts also provided benefits of their experience on the subject of Lessons Learned System design or architecture, particularly Key Codes 8 & 11. This collection of material can provide future designers of Lessons Learned Systems a resource to review.

The second contribution of this thesis is a further development of Lessons Learned System decomposition. It has expanded the Handling characteristic into a Handling Variable Set. The Handling Variable Set is tool that can compress a large quantity of qualitative data such that it remains encompassing but allows multiple Lessons Learned Systems to be compared with less effort. The development of the Influence Diagrams has also advanced the decomposition by providing a cause and effect relationship between the Handling Variable Set and the three major tasks of a Lessons Learned System. This thesis has further decomposed one characteristic of a Lessons Learned Systems and provided a methodology to decompose the other characteristics.

The third contribution to the body of knowledge is that it has provided some evidence that supports the principles expounded in Chapter II. One principle of knowledge management is the importance of management support. The importance of management support was cited a few times in the success of a Lessons Learned System.

Knowledge management principles also cited the importance of being pro active in the collection of lessons and the potential difficulties in requiring a worker to perform a task and record lessons. Existing Lessons Learned System's experience supported these. Lessons Learned Systems that were passive had concerns about receiving lessons. Those that required worker development of input as part of the task cited that success in receiving lessons was very dependent on management enforcement of the requirement.

Knowledge management principles also provided numerous suggestions for transforming an experience into a quality form. This has been recognized by Lessons Learned Systems by the fact that practically all existing Lessons Learned Systems incorporate some editorial review prior to dissemination. The fact that the information provided in Chapter IV did not give specific details of the review could be interpreted as the need for the editorial review to be tailored to the specific lesson and organization.

The principles of Organizational Learning were also empirically supported to some degree. Those Lessons Learned Systems that were strong in the implementation task used methods that it could be argued promoted tacit learning from the explicit. The use of policy implementers to write lessons prior to dissemination required tacit knowledge to be understood by the policy implementers, the key to organizational learning. Also the task of requiring a response from Lessons Learned targets required a tacit understanding to begin.

The thesis as a whole contributes to the body of knowledge of Lessons Learned Systems by providing examples of Lessons Learned Systems, a method to code a characteristic, by the Handling Variable Set in this case, and some work in the cause and effect of operational choices to the tasks of a Lessons Learned System through the Influence Diagrams. As the importance of Lessons Learned Systems become realized, designers can refer to this thesis as a resource.

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